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THE AIR FORCE IN SPACE

FISCAL YEAR 1964

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USAF HISTORICAL DIVISION
LIAISON OFFICE

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THE AIR FORCE IN SPACE

FISCAL YEAR 1964

by

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[redacted]

USAF HISTORICAL DIVISION

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FOREWORD

The Air Force in Space, Fiscal Year 1964, the seventh in a series of historical monographs on the subject, discusses USAF space planning, relations with the civilian space agency, and the impact of Secretary of Defense policy on USAF man-in-space aspirations. The monograph reviews the decision to terminate the Dyna-Soar development, the Air Force's support and role in Gemini, and a number of active projects including Titan III, communication satellites, and the antisatellite system.

Four previous historical monographs published in this series, also entitled The Air Force in Space, covered the years 1960 through 1963. In addition, the USAF Historical Division Liaison Office prepared two other studies: An Air Force History of Space Activities, 1945-1959, from which was drawn a smaller monograph, The Threshold of Space, 1945-1959.

Max Rosenberg
MAX ROSENBERG
Chief
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I. AIR FORCE AND NATIONAL SPACE PROGRAMS AND POLICIES [redacted]

([redacted]) Much as in the preceding year, while suffering some setbacks, the Air Force progressed significantly toward attaining some of its long range space objectives during fiscal year 1964. Long-pending decisions were made by the Office of the Secretary of Defense (OSD) on USAF man-in-space projects. The almost predictable loss of Dyna-Soar was compensated for in part by approval of a manned orbiting laboratory (MOL). The Titan III space booster and large solid rocket motor technology attained programmed milestones. The antisatellite program became operational on schedule, and important breakthroughs were made with missile detection satellites.

(U) Also as in 1963, outside factors frequently influenced the shape and scope of USAF space activities. Projects were often conducted in concert with those of other national agencies. Foremost among these were the National Aeronautics and Space Administration (NASA), the Atomic Energy Commission (AEC), and the Department of Commerce, through the Weather Bureau. Moreover, even broader influences were felt, for 1964 was the year of international negotiations on how to use space for the benefit of the whole world.

Air Force Space Planning in 1964

(U) The Air Force Space Plan of 1961 and the 1962 USAF Five-Year Space Program, whatever their shortcomings, had had the merit of crystallizing USAF thinking on space. This became more evident in 1964 when, during staff coordination of the Air Force Space Objectives paper, the only dispute concerned the need and timing of its publication while its content went unchallenged. This solidarity of thinking probably also reflected the influence of closer informal discussions with the Director of Defense Research and Engineering (DDR&E) on matters of space.

[redacted]

[redacted]

([redacted]) The Air Force Chief Scientist, Dr. Launor F. Carter, had criticized the Air Staff in 1962 for not first ascertaining OSD views and attitudes in developing the five-year program. Since completion of the Five-Year Space [redacted] Program document in October of that year, closer rapport had definitely developed between the Air Force and OSD. Lt. Gen. James Ferguson, Deputy Chief of Staff, Research and Development (DCS/R&D), Under Secretary of the Air Force Brockway McMillan, and Dr. Alexander J. Flax, Assistant Secretary for Research and Development, among others, frequently consulted informally with Dr. Harold Brown, DDR&E, and his staff. As a result, the USAF approach to space planning and programming became much more practical and realistic.

USAF Space Objectives

(U) During fiscal year 1964 the Air Staff completed the long-suspended revision of the Air Force Space Plan, which was first published in September 1961. When he approved the plan at that time, Secretary of the Air Force Eugene M. Zuckert suggested that it should receive periodic revision as conditions changed.

([redacted]) In the early summer of 1962 an Air Staff working group, organized to revise the plan, temporarily halted its work because of two other USAF planning efforts then under way. One, already mentioned, involved preparation of the USAF Five-Year Space Program, which was published on 19 October 1962 and was considered by Secretary Zuckert as "the first integrated long-range plan" for space.[1]

(U) Soon after its publication, USAF planners became involved in Project Forecast, the special study group organized by Secretary Zuckert and General Curtis E. LeMay, the Chief of Staff, in the spring of 1963 to examine trends in

[redacted]

science and technology and their possible impact on the Air Force in the decade between 1965 and 1975. Consequently, the Air Staff decided to delay space [redacted] revisions, pending receipt of the Forecast findings.

(U) By September 1963, Maj. Gen. John W. Carpenter III, Director of Plans, had concluded--on the basis of preliminary reports--that Forecast would neither produce significant new space objectives nor reach any conclusions inconsistent with proposed revisions to the 1961 Space Plan. Moreover, General Carpenter noted that the revised draft, now called, "USAF Space Objectives," was com[redacted] compatible with the USAF Five-Year Space Program.[2]

(U) However, General Ferguson, who felt that the meager impact achieved by the 1961 plan and the five-year program had not been worth all the effort invested in them, opposed another formal attempt to define space goals. He asserted that great progress had been made--primarily through his agency's efforts--in changing for the better the receptivity and attitude of OSD toward USAF space proposals. In addition, the fact that neither Forecast nor the proposed USAF Space Objectives had established any new goals attested, Ferguson believed, to the soundness of the Air Force's thinking on space over the past few years.

(U) The Directorate of Plans, while conceding these arguments, nevertheless persisted in its course, believing that a more specific definition of desired operational capabilities would appropriately support the research and development goals of the five-year program and would not deleteriously affect the improving USAF-OSD relations.

(U) A draft prepared by Plans was briefed to the Space Panel on 13 November [redacted] and to the Air Staff Board on 20 November, and after minor staff objections to the timing of its publication were overcome, General LeMay approved the USAF Space Objectives document on 20 April 1964. LeMay's foreword to the paper declared, in part, "The consolidated guidance provided in this document identifies

military space capabilities which are goals of USAF through 1970." [3]

([redacted]) The USAF Space Objectives paper reviewed the continuing cold war between the United States and the Soviet Union and the undiminished threat to U.S. security. In this context, the objective of the Air Force was the timely development of fundamental and requisite military space capabilities that would lead to an improved overall U.S. military capability and counter actual or potential Soviet military postures.

([redacted]) While the full potential of space would have to await resolution of many technical and economic problems, a variety of missions could be performed in support of fundamental military tasks. The document identified several essential space operational objectives that could be attained in the 1960's: [4]

1. A satellite system(s) able to collect on a systematic or request basis pre-strike and post-strike intelligence data of Russia and Communist China.
2. A credible and operationally effective missile destruction and alarm system.
3. A ground or atmospheric launched, non-orbiting satellite interception and negation system.
4. A system to inspect and, if appropriate, to "negate" or destroy uncooperative satellites.
5. A satellite system providing an enhanced global command control communications network.
6. A satellite system providing timely observation of militarily important global weather conditions.
7. A recoverable satellite system able to perform co-orbital rendezvous and docking operations in carrying out space rescue and logistic support missions.

([redacted]) The Objectives document also outlined space operational goals which had to await extensive technological advances. These included a system to perform boost or mid-course interception of hostile missiles; a fast reacting and economical launch system capable of injecting various satellites into orbit; and large scale, manned maneuverable vehicle systems containing elements of defense, strike,

reconnaissance, and command control, located in relatively permanent orbits.

Project Forecast Space Recommendations

(U) If, as the Directorate of Plans had suggested earlier in the year, Project Forecast had come up with virtually nothing new on space, the rationale adopted by its space panel was an innovation. While panel findings were perfectly consistent with the technical objectives of the 1961 Plan, the USAF Five-Year Space Program, and the 1964 Objectives paper, they comprised, by design of the panel's members, the most credible Air Force planning document on space yet. Considering that Forecast was chartered to project thinking some 10 years into the future, its report was quite conservative. As one of its members, Col. Frank G. Richie, noted, "The panel seized upon Forecast as an opportunity to do something reasonable within the realities of current technology and funding restraints to assure effective Air Force space programs and systems for the subject period."[5]

([redacted]) From an analysis of potential applications and possible enemy activities, the panel concluded that several categories of systems were immediately required to provide a balanced military space program throughout the next decade. Of prime consideration was the class of systems needed to support earth-based military operations, and the panel recommended continuance of current missile detection, satellite communication, and space environment monitoring (radiation) programs. It also restated the need for an integrated space command and control network. Aspects of this system would include mission control 100 percent of the time, real-time control and readout, and real-time onboard navigation information for rendezvous and reentry.[6]

([redacted]) A second important group comprised the satellite detection-interception-inspection-negation missions. Here, the panel urged continuance of interim Program 437 and acceleration of its planned follow-on. It urged that the space detection

and tracking system (Spadats) be improved in coverage, accuracy, reaction time, and survivability. It asserted that the need for and the technical approach to a satellite inspection capability should continue to be studied and defined. The Air Force also should continue to study the technical approaches, particularly the capabilities, of the 893 antisatellite and MOL programs.

([redacted]) The third class of desired systems described by the panel included reuseable space launching vehicles and maneuverable spacecraft. The latter, of course, contained the essence of the discontinued Dyna-Soar, emphasizing lifting body vehicles of modest lift/drag suitable for application to manned reuseable vehicles. A number of advanced technological improvement tasks comprised yet another area of activity. Here, the panel recommended an intensive effort on the development and improvement of spacecraft subsystems, such as sensors, low power computers, millimeter wave hardware auxiliary power sources, and expandable structures.[7]

([redacted]) Indicative of a more realistic attitude in the funding area was the Forecast statement of the necessity of firm fiscal constraints in projecting a USAF space program for the next decade. The Forecast Space Panel believed that "it was not necessary to curtail vital programs in order to live within this ground rule." The panel estimated that just over $2 billion annually would be required to support its recommended space program during the next five years.

([redacted]) In conclusion, the Forecast Space Panel strongly urged that the Air Force implement its recommendations in order to achieve[8]:

> ...the military mission capabilities which are called for by the National Policy of using space to help keep the peace, and [which] are potentially obtainable through systematic exploitation of the current and advanced technological opportunities surveyed within this report. [redacted]

U.S. Foreign Policy and the Air Force Space Program

(U) Throughout this period the United States actively followed a policy of seeking peaceful cooperation with the Soviet Union. Frequently the results of such international negotiations had a direct or implicit impact on USAF space plans and programs. Chief among the agreements actually reached was the limited nuclear test ban treaty negotiated in Moscow and signed by President John F. Kennedy on [redacted] 7 October 1963 after Senate ratification in September.* 9

(U) In its final form, the treaty prohibited nuclear explosions in the atmosphere, under water, and in outer space. Two aspects of USAF space programs were immediately affected. One of them, the blackout effect of nuclear explosions in space, was an area in which, General LeMay warned, the Soviets probably already had more knowledge than the United States. The other involved the antisatellite project. As discussed in a subsequent chapter, the ban was partly responsible for the Air Force and OSD turning toward nonnuclear technology in this area.

([redacted]) In September 1963 President Kennedy, in an address to the United Nations, asked for international cooperation in the regulation and exploration of space. He specifically held out the possibility of a joint American-Russian expedition to the moon. He followed up his address by directing the Administrator of NASA, James E. Webb, to assume the lead within the government for the development of a program of cooperation with the Soviet Union in outer space.[10]

([redacted]) In this connection, the Air Force reported to the Joint Chiefs of Staff (JCS) on 21 April 1964 that it could identify no significant military advantage in NASA's lunar venture because its own interests still lay in near-earth space

* The subject of the Air Force and the Nuclear Test Ban Treaty is discussed in some detail in Bernard C. Nalty, The Air Force and Nuclear Testing, 1958-1964, AFCHO, July 1965.

operations. Nevertheless, General LeMay remarked during a review of proposed NASA papers on American-Russian cooperation that the United States should proceed cautiously because space technology was closely related to, and in some instances interchangeable with, the technology upon which USAF strategic deterrence capabilities were based. [11]

(S) The JCS and the Air Force also were called upon to review the U.S. position during the bilateral talks between the United States and the Soviet Union which led to the United Nations resolution of 13 December 1963 on the use of outer space. Subsequently, the State Department continued to solicit Department of Defense (DOD) and the Air Force views on drafts of position papers on certain of the declaration's provisions. Two such papers, drafts for the U.S. delegates to the U.N. committee on peaceful uses of space, dealt with "Assistance to and Return of Astronauts" and "Liability for Damage Caused by Objects Launched into Outer Space." At its 8 February meeting the JCS agreed that from the standpoint of security these drafts were suitable. [12]

DOD-NASA Relationships

(U) During fiscal year 1964 the trend toward closer cooperation between DOD and NASA continued as additional agreements were reached on defense and space agency responsibilities for range instrumentation ships and use of Thor and Atlas-Agena vehicles. The Air Force also took steps during the year to clarify previous agreements governing support of NASA.

USAF Support Relationship with NASA

(U) OSD policy on support of NASA had been spelled out by DOD Directive 5030.18, 24 February 1962. It authorized defense agencies to make resources available to NASA so the nation's total assets could be efficiently employed to

DOD SUPPORT OF NASA'S MERCURY PROGRAM
(1 July 1959 - 13 June 1963)

AGENCY	Type and Amt of Support	Cost in Thousands Dollars Reimbursed	NON	Total
Air Force Costs		83,836	10,416	94,252
Space Systems Division	Boosters, launch crews and facilities, engineering, a/c spt. 23 people plus contractors. 216 a/c hrs.	73,862	1,351	75,213
Air Force Missile Test Center	Operation of 3 network stations, launch spt, asst in recovery. 173 people, 2,722 a/c hrs.	6,569	5,652	12,221
Air Proving Ground Center	Operation of 1 network station, asst in network trng. 21 people 551 a/c hrs.	22	956	978
AF Communications Service	Comm eng and instl; communicator deployment to contingency sites. 8 people.	140	201	341
Military Air Transport Service	Airlift personnel and cargo	1,040	69	1,109
Air Rescue Service	A/c spt to theater cdrs; deploy forces for contingency recovery. 6,426 a/c hrs.	1,063	260	1,323
Aeronautical Chart & Info Ctr	Cartographic service. 10 people	5	150	155
Tactical Air Command	A/c spt for contingency recovery. 545 a/c hrs.	42	87	129
Air Defense Command	245 radar a/c spt hrs.	3	271	274
U.S. Air Forces, Europe	Deploy to remote sites for contingency recovery. 2,691 a/c hrs.	720	279	999
Pacific Air Forces	Deploy to remote sites for contingency recovery. 331 a/c hrs.	362	189	551
Other	Air Weather Svc; AECD; and AFFTC	8	911	919
Navy Costs		12,255	19,830	32,085
Army Costs		2,300	730	3,030
Bioastronautics (combined services)		1,478	2,390	3,868
TOTAL DOD COSTS		99,869	33,366	133,235

(SOURCE: Summary Report DOD Support of Project Mercury, July 1959-June 1963, 11 Sep 63).

achieve common civil and military space objectives. In most areas, the directive made the Air Force responsible for furnishing the bulk of DOD support.[13] The Air Force's experience in supporting Project Mercury, plus the realization that NASA would become increasingly active on both the Air Force Eastern Test Range (AFETR) and Air Force Western Test Range (AFWTR), led the Air Force to reassess the rationale of its support of the space agency.

(U) On 24 December 1963 the Office of the Chief of Staff provided the Air Force Systems Command (AFSC) and other affected commands with additional guidance on the support of the space agency. All support arrangements between the Air Force and NASA were to be covered by basic DOD-NASA or USAF-NASA agreements. Implementing agreements, however, would normally be negotiated and signed at the level of command at which the support was provided. Agreements which required additional USAF resources would specifically identify such resources on a time-phased basis. Basically, it was USAF policy to provide technical, logistic, operational, and certain other support for NASA programs, when required, to the extent military requirements and capabilities permitted. Contrary to the 1962 OSD directive, the Air Force intended that as much as possible of this support should be on a reimbursable basis.[14]

NASA-DOD Agreement on Instrumentation Ships

(U) On 14 February 1964 OSD and NASA jointly announced that range instrumentation ships required by the two agencies would be pooled and operated by the Defense Department on behalf of both. By the end of 1967 the pool would have 20 operational tracking ships. NASA would participate in all phases of the program, including system engineering and development of plans and specifications. The Navy Department was given central responsibility for design, construction, and modification of the ships; the Military Sea Transportation Service would operate

them, and the Air Force, as manager of DOD's ranges, would be responsible for scheduling and ship instrumentation operations.[15]

(U) This arrangement had been forced on NASA by the House Science and Astronautics Committee. NASA had requested $90 million to convert three ships from the maritime reserve and then use them for tracking, command, and data acquisition functions in the Apollo program. When testimony during review of the 1964 authorization revealed that NASA had formed its requirement independently of DOD plans for more tracking ships, the committee directed the two to pool their tracking ships requirements and resources--a step which the Air Force and DOD had urged a year earlier.[16]

Apollo Instrumentation Aircraft

(U) The precedent of the ship agreement and continued Congressional interest in consolidation of resources then led NASA on 21 January 1964 to seek DOD assistance in providing instrumented aircraft to support the injection phase of Apollo operations. A National Range Division study completed on 28 May noted a need for C-135 type aircraft to allow telemetry recording and voice communications with the Apollo lunar vehicle for 10 minutes after a launching. AFSC could make eight aircraft available, while the other four could come from KC-135B procurement.[17]

USAF-NASA Agreement on Agena Vehicles

(U) On 9 August 1963 the Air Force and NASA consummated an agreement defining and delineating responsibilities between the two on the space agency's use of Atlas, Atlas-Agena, and Thor-Agena. The agreement, signed by Lt. Gen. Howell M. Estes, Jr., AFSC Vice Commander, and Robert C. Seamans, Jr., NASA Associate Administrator, superseded one of February 1961 governing Agena B. The Air Force, through Space Systems Division (SSD) would design,

engineer, and test basic Atlas and Thor boosters and Agena D stages. NASA would buy these from the Air Force and carry out its own launchings at the Atlantic Missile Range (AMR). However, the Air Force would conduct all of NASA's Agena launchings from Vandenberg AFB, Calif.[18]

Reaffirmation of February 1961 Launch Vehicle Agreement

(U) On 23 February 1961 NASA and DOD signed a national launch vehicle program agreement committing both to a policy of initiating development of new launch vehicles and boosters only with the written approval of the other. By the spring of 1964, there appeared claims that use of this procedure was deteriorating. For example, the Air Force had coordinated its Agena and Thrust augmented Thor improvements with the Aeronautics and Astronautics Board (AACB) only after they had become accomplished facts. The Air Force explanation was that they were improvements rather than initiations of new vehicles and, consequently, did not come under the agreement.[19]

[redacted] On 3 April 1964 Cyrus R. Vance, Deputy Secretary of Defense, reemphasized that the 1961 launch vehicle agreement still was effective and that OSD foresaw no set of circumstances which would require an exception to its provisions. He advised the Secretary of the Air Force and others that DOD would not initiate development of a launch vehicle or space booster or a new combination of vehicles without the written approval of NASA.[20]

(U) In the meantime, the Air Force had begun what would become the first phase of a joint DOD-NASA study of national launch vehicles to define production and utilization requirements for the 1965-70 period. Secretary Zuckert initiated the Air Force effort on 13 March. By the middle of May, when the Air Force had completed its analysis, Dr. Brown and Dr. Seamans had agreed that this effort should extend into a second phase in which NASA would participate.[21]

NASA Proposals for a Vandenberg AFB Delta Launch Capability

[redacted] By March 1964 NASA had concluded that the Delta vehicle* as then configured could not handle all its foreseen missions if launched at the Atlantic Missile Range. After reviewing possible alternatives, including an improved Delta, Dr. Seamans on 10 June proposed establishing a NASA launch capability at Vandenberg, thereby permitting polar orbiting with the existing booster. He also suggested Delta could be used to support the Navy's Project 435 navigation satellite.[22]

(U) On 18 June, after reviewing the NASA proposal and Air Staff reactions to it, Dr. Flax objected on several counts. As he told DDR&E, the establishment of a Delta launch pad on a sole-use basis and the proposed assignment of launch responsibility to NASA for Project 435 were both impractical and improper. He thought it more appropriate that any agreement make only general reference to payloads that fell within the capability of Delta since a final decision on the launch vehicle for the Navy project was a question beyond the scope of Seamans' proposal.+ Dr. Flax asked Dr. Brown to withhold action until the Air Force could present a more detailed response.[23]

Realignment of DOD Missile and Space Test Ranges[24]

(U) After lengthy studies and discussions within DOD, on 16 November 1963 Secretary of Defense Robert S. McNamara ordered the consolidation under USAF management of some major missile and space test range facilities. The Air Force was directed to establish a central authority to coordinate the planning for missile and space vehicle activities at the Atlantic Missile Range, the Naval Missile

* A three-stage vehicle used to launch Tiros, Echo, Explorer, and other space agency satellites. It also was under consideration to launch military payloads.
+ The question of the booster for Project 435 is discussed in Chapter IX.

[redacted]

Facility, Point Arguello (NMFPA), and Vandenberg AFB. The NMFPA and the space tracking facilities in the Pacific would be transferred to the Air Force. Antimissile test support facilities at Kwajalein would be transferred from the Navy to the Army. The Air Force Satellite Control Facility at Sunnyvale, Calif., also would come under the new authority.

(U) To carry out these directives, the Air Force on 2 January 1964 established the National Range Division (NRD) under the Air Force Systems Command with temporary headquarters at Andrews AFB, Md. On the same day several provisional organizations were organized which ultimately became the major components of the National Range Division. As finally designated on 15 May 1964, these were the Air Force Eastern Test Range, formerly Atlantic Missile Range; the Air Force Western Test Range,* formed from the facilities transferred from the Navy, and the Satellite Control Facility (SCF). On 18 June the Air Force issued orders assigning jurisdiction, control, and accountability of Point Arguello to Vandenberg AFB, concurrent with its transfer from the Navy on 1 July 1964. Secretary McNamara was generally pleased with these plans, but he had some reservations about the proposed role of the SCF in the new organizational alignment. For that matter, Under Secretary of the Air Force Brockway McMillan was also dissatisfied. Consequently, at the end of the fiscal year, AFSC was reconsidering its plans for the tracking facility.[25]

* AFWTR would not actually assume operations from the Navy until February 1965.

[redacted]

II. THE IMPACT OF OSD POLICY ON USAF MAN-IN-SPACE ASPIRATIONS

([redacted]) For some time the Air Force had wanted to put a man into space to prove that he could perform various military missions in that medium. To this end, it had pursued several projects which had reached varying stages of maturity by July 1963. The farthest along, the one in which the Air Force had the deepest interest and commitment, was Dyna-Soar, a hypersonic delta-winged glider, whose primary objective was to demonstrate the feasibility of maneuverable re-entry and the utility of military man in space.

([redacted]) The Air Force also had studied and sought OSD approval for development of a space station or laboratory. Pursued under various designations, the idea had crystallized as the Military Orbital Development System (MODS) in a program change proposal of November 1962.

([redacted]) During fiscal year 1963 the Air Force also investigated the aerospace plane concept whereby a vehicle could boost itself into orbit and return to a conventional landing field. Through Program 651, an advanced development program comprising several propulsion and aerodynamic elements, the Air Force hoped to demonstrate system feasibility. However, because of low funding, the program did not promise much in tangible results before the 1970's.

([redacted]) Finally, for a number of reasons the Air Force had become interested in participating in NASA's Gemini effort. Although it had hoped for a direct role, at year end, by OSD direction, it was confining itself to developing with NASA a series of experiments to be conducted aboard the Gemini craft.

([redacted]) At the beginning of fiscal year 1964 it appeared that there would be some kind of military manned space program and that it would involve a space station. But its relationship to Gemini, the extent of USAF participation, the

role of Dyna-Soar--all remained open questions, seemingly weighted in favor of a greater Gemini role.[1]

Webb-McNamara Agreement on National Space Station Policy

(U) In the spring of 1963, while the Air Force was drafting plans to let study contracts for a national orbital space station (NOSS)* based on the MODS concept, McNamara and Webb were engaged in negotiations on the subject. On 27 April they agreed that neither agency would initiate a space station development without the approval of the other, and that they would await recommendations of the AACB's manned space flight panel before taking further steps.[2]

(U) The panel submitted its recommendations to the AACB on 27 June, and the board endorsed them in early August. As noted below, the panel's proposal fell short of McNamara's desires and the Secretary continued to press Webb for a more formal agreement. In essence, the panel called for mere coordination and exchange of information between the two agencies. McNamara thought this was insufficient; he wanted an agreement on a joint course of action.[3]

(U) By this time--the first week in August--another avenue had opened for McNamara to attain his objectives. During a mid-July regular meeting of the National Aeronautics and Space Council, its chairman, Vice President Lyndon B. Johnson, had noted with pleasure the high degree of cooperation between NASA and DOD in the Gemini program. However, it was apparent there was no such agreement with respect to space stations. On 22 July the Vice President solicited the views of Webb and McNamara on what needed to be done. He asked Webb to explore the non-military potential of space stations, while Secretary McNamara was requested to submit a paper expressing their possible uses in maintaining

* The "national" was later dropped. In late August 1963 DDR&E authorized the Air Force to negotiate three OSS study contracts totaling $1 million. However, the contracts were not let until May 1964, the delay caused by the need to revise work statements to take into account the MOL project.

was requested to submit a paper expressing their possible uses in maintaining national security. [4]

([redacted]) McNamara responded to the Vice President's request on 9 August and came out firmly for a space station project. As he saw it, "The real potential of manned space flight may not be understood until there has been the opportunity to conduct a program of long duration multi-manned orbital flights in a facility which permits men to move about and perform useful tasks." He pointed out the immediate utility of a space station as a laboratory and development facility and suggested the probability that a station would evolve into a vehicle directly useful for military purposes. While he did not press for assignment of the project to DOD, McNamara stated his view that initiation of an orbital space station project would necessitate assignment of a new national mission by the President on behalf of all interests. [5]

(U) The Secretary concurrently resumed discussions with Webb about NASA and DOD cooperation. After reviewing the AACB's proposal for further coordination on manned orbital space stations, he wrote Webb on 8 August, "I am not satisfied that a mere exchange of information is sufficient in this important national effort." He suggested they sign a new formal agreement, a draft of which he forwarded, to insure that the efforts of both agencies were coordinated. [6]

(U) The space agency disliked the OSD draft and, on 17 August, submitted an alternate version. Although Secretary McNamara still had some reservations, on 16 September he acknowledged that the discussions had been carried about as far as was useful and he signed NASA's substitute. [7] In sum, the two agencies agreed that insofar as was practicable, requirements for vehicles "larger and more sophisticated than Gemini and Apollo" would be encompassed in a single project. Advanced exploratory space station studies undertaken by either would be coordinated through AACB which would also evaluate concepts evolving from the studies.

DOD and NASA would then jointly prepare a national requirement statement that would also include a recommendation on which agency should direct the work. Should the President decide to proceed, a joint NASA-DOD board would formulate specific objectives and approve experiments to be conducted.[8]

December 1963 Decisions

(U) McNamara's growing interest in a space station was paralleled by his disenchantment with Dyna-Soar, the sole manned military space project then under way. In January 1963 he had directed DDR&E to evaluate Dyna-Soar's advantages and disadvantages as compared to NASA's Gemini and submit recommendations on a future approach. Studies and reviews undertaken by DDR&E over a period of many months reached a climax on 14 November 1963 when Dr. Brown recommended that Dyna-Soar be terminated. In its place, he proposed that the Air Force expand its ASSET operations* and begin development of a new military space station.[9]

In his proposal, Brown sketched six alternate space station configurations. By "space station" he meant a long-life orbital vehicle which could be resupplied by other spacecraft, to and from which personnel could be ferried, and in which men could exist in a comfortable and roomy "shirtsleeve" environment. The station would serve as a military laboratory in which the crew could perform various tasks. Common to all proposed configurations was a modified Gemini capsule to be employed as a ferry and return vehicle for personnel. His proposals envisioned 30-day crew rotation.

* The first delta-winged ASSET (aerothermodynamic elastic structural system) was launched down the AMR on 18 September 1963 by a Thor rocket. The vehicle reached an altitude of 35 miles before reentering at 10,900 miles per hour. Data was obtained on temperatures and pressures during the 20-minute flight.

([redacted]) Of the six alternatives he had considered, the one which appealed to Brown most involved a 2,140-cubic-foot, four-room, four-man station launched by Titan IIIC. Supply and subsequent ferry operations would be performed by vehicles also launched by Titan III C. On the basis of preliminary studies, the Defense Research Director believed that a four-man station would be the minimum size to permit meaningful performance of military experiments. A station of this size could be much more easily equipped for reliability and long life. Experimental equipment could be more elaborate and, therefore, more effective. The lifting ability of Titan III would be employed to its best advantage. The cost of this approach would be only moderately larger than that of the others.[10]

([redacted]) Subsequently, in accordance with the DOD-NASA space station agreement of September 1963, Dr. Brown submitted his proposal to space agency officials and met with them to discuss it. It soon became apparent that NASA considered a DOD space station, with the proposed ferrying, docking, and resupply operations, as possibly impinging on NASA's mission area. Reporting on 30 November to the Defense Secretary, Brown said that it was likely that they would advise Mr. Webb to agree, in principle, to a separate manned military space program. However, NASA was not yet certain of its future needs for a space station and was, therefore, reluctant to agree irrevocably to assignment of such a program to DOD. Instead, NASA offered a counter-proposal suggesting that DOD could fulfill its needs by developing an orbiting military laboratory which did not involve the complications of personnel ferry, docking, and resupply. In essence, NASA proposed a system very similar to the original MODS proposal. It would consist of the Gemini capsule weighing 7,000 pounds attached to a pressurized and habitable military test module weighing approximately 15,000 pounds, the combination to be injected into orbit by a Titan IIIC.[11]

([redacted]) In Brown's view, the NASA plan had some merit as well as some drawbacks. It was an entirely reasonable and orderly approach which might well be followed whether or not the real objective was the establishment of a space station. Its modular nature would permit alteration in objectives as work progressed. Full advantage would be taken of the Titan III and Gemini developments.

([redacted]) On the other hand, although much military testing could be done in successive launchings of this condiguration, he felt that the proposal for the first-year flight program was not fully equivalent to a space station because it lacked the operations of rendezvous, docking, resupply, and crew rotation. DOD agreement to the NASA proposal would also postpone the decision on [redacted] management responsibility for a national space station program since NASA's proposed system would not be defined as a station, but rather as a laboratory. As such, Brown believed that it did not really fit within the context of the Webb-McNamara agreement on orbital systems larger than Gemini and Apollo, but rather within the spirit of the Gemini agreement in which both agencies agreed they would not undertake any new earth orbital space projects without the approval of the other. While conceding NASA's proposal would be acceptable as a near-term manned military space program, Brown thought it inferior to his preferred alternative and he restated his earlier recommendation.[12]

([redacted]) At this time Dr. Brown also formally submitted copies of his 14 and 30 November memoranda to the Air Force and requested comments. These papers set in motion intensive effort on the part of the Air Force to save Dyna-Soar (see Chapter III). However, all arguments were rejected as McNamara now decided to kill Dyna-Soar and investigate a manned orbital laboratory and an expanded ASSET effort to "substantially expand our knowledge of precision

reentry..." On 10 December, he made a public announcement to this effect.[13]

"A Plus With Some Minuses"

[redacted] Although the Air Force had defended Dyna-Soar to the last and had, moreover, advocated an approach to a manned orbital laboratory using the Dyna-Soar glider, it now had to adjust to the decision. As a matter of policy, "it would do its utmost to provide the Air Force resources, management, and dedication required for successful completion of the new program as defined by OSD."[14]

(U) Without doubt, the Air Force, and to some extent, space technology, suffered a setback when Secretary McNamara cancelled Dyna-Soar. However, as Air Force and Space Digest magazine described it, the MOL decision represented "A Plus with Some Minuses." Its editor noted that "even a 'minimum' size MOL, six or seven feet in diameter and less than twenty feet long, should house enough equipment to enable the Air Force to come up with solid answers concering man's military usefulness in low earth orbit." Missiles and Rockets, a trade journal, editorialized in similar vein. "We believe," the magazine said, "the industry and the Air Force are confronted here with what they have long been seeking--initiation of a manned military space program with considerable promise for the future."[15]

Establishing a MOL Management Structure

[redacted] As early as August 1963, four months before the OSD decision on Dyna-Soar, MOL, et al, the Air Staff was thinking about reorganizing [redacted] to accommodate management of a national space station program. Since by this time the original MODS program change proposal was being revised to reflect the National Orbital Space Station concept, the need to reorganize to take into account the changes was clear to General Ferguson who recommended immediate

action to the Vice Chief of Staff. In a memorandum on 7 August, Ferguson noted there was already considerable high-level government interest in space stations. Implementation of the agreement to coordinate NASA and DOD space station studies would require extensive support from the Air Staff. Moreover, he observed that DDR&E had established a full deputy for space and NASA was organizing in some depth to establish a space station program. In view of these developments and the USAF hope to be assigned the national mission, the Air Staff would have to adjust its organization to cope with the challenge. General Ferguson did not believe that any Air Force field agency was in a position to handle the problems posed. To achieve the necessary competence, Ferguson said, the Air Staff should at once establish a space station focal point.[16]

(U) The Vice Chief of Staff agreed and on 15 August the new Office of the Deputy Director of Development Planning, Space, headed by Col. Kenneth W. Schultz, was established. As the Air Staff focal point for USAF interest in the national space station planning effort, it was responsible for supporting the Under Secretary of the Air Force and the Assistant Secretary, R&D, on space station matters. The office also was to be responsive to the Deputy Director for Space, DDR&E, Dr. Albert C. Hall.[17]

(U) Under Secretary McMillan recognized the wisdom of creating the new office and agreed that it was the likely agency to coordinate space station studies with NASA. Later, after the Webb-McNamara space station agreement of 16 September 1963, he suggested several additional functions that the new office could perform.[18]

(S) Following McNamara's announcement of 10 December, AFSC on 6 January 1964 submitted a paper to Headquarters USAF which called for establishing a MOL office, headed by its commander, General Bernard A. Schriever, to serve as the management agency between an SSD system project office (SPO) and the Office

of the Secretary of the Air Force (OSAF). McMillan initially favored this proposal. He saw a need for a MOL program office in the Washington area which would program, budget, and manage overall resources and assure support from all [redacted] elements of AFSC. He thought it should monitor MOL progress and provide timely information in a uniform way to the Air Staff, OSAF, and DDR&E. He also favored appointment of a general officer as a special assistant to the Secretary of the Air Force to keep him continuously informed of actions taken by the MOL office and the Air Staff and of the status of relations with NASA.[19] However, despite McMillan's general concurrence with AFSC's proposal, it was not immediately acted upon.

(U) Instead, on 8 June, at McMillan's request, the Office of Deputy Director of Development Planning, Space was upgraded and redesignated the Office of the Assistant to DCS/R&D for MOL Program. In addition to normal Air Staff functions associated with program management, the new office was directly responsible to the Secretary of the Air Force for all MOL matters. This action reflected the universal understanding in the Air Staff and OSAF that MOL would involve an extraordinary degree of intragovernmental and interservice relationships. It was also clear that the Secretary of the Air Force would have an abnormal concern with the details and progress of the project, as would DDR&E and the Secretary of Defense.* [20]

* In the months following, an intensive USAF planning effort to define MOL experiments and missions led to further changes in the management structure. On 18 January 1965 the Secretary of the Air Force established the new post of Special Assistant for MOL under his immediate supervision and a MOL Policy Committee to provide program guidance. Subsequently, a MOL program office was established at the Secretarial level, headed by General Schriever, special security procedures were adopted, and all MOL planning and programming functions and responsibilities were withdrawn from normal Air Force and Air Staff channels. As a consequence, there will be no further coverage of MOL in AFCHO histories.

III. TERMINATION OF THE X-20 DYNA-SOAR

([redacted]) By December 1963, when the blow actually fell, the Dyna-Soar cancellation came as no surprise. A number of signs had pointed to its premature end as the program barely survived the previous OSD review. In January 1963, Secretary McNamara had initiated a review of the X-20 vehicle and its relationship to NASA's Gemini, citing the tremendous and, in his view, competitive costs--approximately $800 million each--of the two segments of the national space effort. Initially, he asked DDR&E for information on what military capability one system could provide that the other could not. Later, in March, he extended the review to study the applicability of the two programs to specific military missions. At that point, he felt the emphasis should be on what jobs could be performed in orbit and how to do them and to worry later about reentry techniques. As the OSD review proceeded, John H. Rubel, Deputy DDR&E, raised the disturbing questions, "What would be lost if the project were cancelled and its principal objectives not attained on current schedule, or at all?"[1] Subsequently, when OSD repeatedly declined to make decisions on critical Dyna-Soar funding crises during the first quarter of fiscal year 1964, Air Staff officials foresaw the project's doom.[2]

([redacted]) In all probability, the fate of Dyna-Soar was sealed on 24 October 1963 when, in Secretary McNamara's view, USAF officials could show very little progress in answering the questions he had asked in March. The occasion was his visit to the Martin-Marietta Corporation plant in Denver for a review of the X-20 and Titan III programs.* While it is true, as Aeronautical Systems Division (ASD) and contractor officials complained, that AFSC had failed to advise them of the purpose of the Secretary's visit--they had been led to believe that it was merely

* Martin-Marietta was the integrating contractor for Titan III which was to have been Dyna-Soar's booster.

a status review--it is unlikely that under any circumstance they could have given a more satisfactory presentation to McNamara because his questions required policy answers from higher USAF officials.[3]

([redacted]) At the conclusion of the briefing, McNamara asked a series of questions which boiled down to: "What does the Air Force really want to do in space and why?" This had been his question in March, and on this visit he again observed that the Air Force and its contractors were overly concerned with how to get in or out of orbit rather than why the Air Force wanted to get there and what it intended to do there. He asked specifically what the Air Force envisioned for Dyna-Soar after maneuverable reentry had been demonstrated, adding that he could not justify the expenditure of about $1 billion on a vehicle which had no ultimate purpose. At any rate, he was obviously dissatisfied with the answers received, and the program director prophetically noted that Secretary McNamara "probably will not ask us again."

The Decision

([redacted]) Indeed, OSD did not again ask the Air Force anything about Dyna-Soar, for shortly after Dr. Brown in his memoranda of 14 and 30 November recommended that the X-20 be discontinued and the MOL begun. Dr. Flax challenged the a priori assumptions behind the recommendation and declared that it was not supported by detailed technical and cost analysis. He agreed with the decision to proceed with a space station program but felt it should be considered independently of the question of the X-20's future. He observed that no serious consideration seemed to have been given to the X-20 as a possible element of a space station proposal, that only the Gemini and Apollo vehicles had been considered. He noted that either would require major modifications--just as in the case of the Dyna-Soar glider. Also, he pointed out that the X-20 would have a maneuverable

reentry capability and need much less support in the way of recovery forces. To assure emergency recovery during a long orbital flight of a ferry vehicle of the Gemini type, it would be necessary to keep naval and air forces deployed during the entire operation. Flax felt that the costs of such deployment over a [redacted] could easily negate any savings accruing from use of the less expensive Gemini vehicle. Even in the absence of emergency situations, the cost of regular monthly recoveries at sea for Gemini reentry vehicles would substantially exceed the cost of land recovery of the X-20.

([redacted]) Aside from raising the question of application of the X-20 to a space station ferry task, Dr. Flax pointed out that there were possible military applications (which he did not identify, however) which did not involve long stays in orbit but which did require rapid and precise recovery. In addition, the X-20's basic technology was important because it supported not only reentry vehicles, but also an entire class of hypersonic winged vehicles. Both NASA and the Air Force had often insisted that if Dyna-Soar were cancelled, sooner or later another program would have to be established to investigate this technological area. Since some $400 million had already been spent on or committed to Dyna-Soar, Flax thought it unwise to cancel Dyna-Soar and then later initiate a new program with essentially the same objectives. [4]

([redacted]) Forwarding Flax's recommendations to the Secretary of Defense on 4 December, Secretary Zuckert observed that he "would hate to see" the Defense Department drop Dyna-Soar and start something new which might be based on quite optimistic program data and costs. Moreover, he thought it would be difficult to satisfy the Congress and the public on the rationale for such a move. [5]

([redacted]) As part of the USAF response to the Brown recommendation, the Air Staff and AFSC developed a preliminary space station counter-proposal based on the X-20 rather than Gemini, which Maj. Gen. John K. Hester, Assistant Vice

Chief of Staff, forwarded to Secretary Zuckert on 4 December. The Air Staff [redacted] heartily endorsed the objective of achieving a manned space capability in the most practical and least expensive manner, but disagreed with DDR&E that the Gemini approach coupled with Dyna-Soar's demise and initiation of a new lift-drag maneuvering reentry vehicle would achieve this objective. General Hester said he did not believe that this approach would lead to a militarily meaningful way to achieve a low cost, effective manned military capability at an early date. [6]

([redacted]) Three alternative configurations for a manned space station were proposed, each involving the X-20 as the shuttle vehicle for resupply and crew rotation operations. The Assistant Vice Chief asserted that this alternative use of the X-20 would be less expensive and more responsive to military needs than the Gemini space station option recommended by Dr. Brown. In sum, General [redacted] Hester strongly recommended immediate implementation of a three-point package plan: (1) A military space station program using the X-20 as a shuttle and resupply vehicle be initiated under USAF management; (2) the X-20 glider be reoriented immediately as a five-man shuttle and resupply vehicle capable of rendezvous, docking, transfer, and 30-day orbital storage; and (3) the ASSET program be continued at the existing level of effort. Finally, he suggested that if a space project had to be curtailed in the interests of the national economy, Gemini should be so considered.

([redacted]) On 5 December Secretary Zuckert forwarded the Air Staff's study and General Hester's recommendations to OSD. While pointing out that a much more detailed analysis was necessary, he said the Air Staff study clearly indicated no a priori reason for omitting the X-20 from consideration as a potential reentry vehicle for orbital space station or orbital laboratory programs. The X-20 alternative deserved serious consideration for a role in the national manned military space station experiment--if the decision had not been already made. [7]

([redacted]) However, it had. On 5 December Deputy Secretary of Defense Roswell L. Gilpatric* told Zuckert that plans were being worked out for cancellation of Dyna-Soar in January 1964. On 8 December an OSD Subject/Issue paper reduced Dyna-Soar 1964 funds to $70 million and programmed none for 1965. Finally, on 10 December McNamara publicly announced cancellation of Dyna-Soar, substitution of an expanded ASSET program, and the assignment of the MOL project to the Air Force. The Secretary explained that Dyna-Soar was being terminated because DOD required a system to determine the basic question of man's utility in space, rather than one limited, as Dyna-Soar was, to finding means to control the return of man from space. The following day McNamara formally directed Zuckert to terminate Dyna-Soar by 15 December.[8]

([redacted]) On 12 December Dr. Brown formally replied to Secretary Zuckert's memoranda of the 4th and 5th as well as the accompanying Flax and Hester papers. He said that although some of its features might have been attractive, several important factors had ruled out an X-20 role with the MOL. These included OSD's reluctance to undertake the necessary modification of the X-20, the prohibitive financial investment that the expanded X-20 program would involve, and the fact that NASA and the Bureau of the Budget had already concurred in a limited program based on the Gemini capsule.[9]

Termination [redacted]

(U) On 12 December Zuckert directed the Chief of Staff to implement McNamara's instructions. All Dyna-Soar contracts were to be terminated immediately. However, any work considered essential to the orderly compilation of data or for transfer to other programs could be continued temporarily at the discretion of the system program director.[10]

(U) All expenditures of Dyna-Soar funds temporarily ceased immediately after McNamara's 10 December announcement. On the 16th the Air Staff reviewed AFSC's

* Gilpatric was succeeded by Vance on 28 January 1964.

phase-out plan as well as the command's preliminary suggestions for continuing certain development efforts. Secretary Zuckert agreed on the 17th that 10 tasks identified by the program director should continue. At the same time, he imposed an obligation ceiling of $200,000 a month for this work and requested the Chief of Staff to furnish a detailed continuation plan by 7 January 1964.[11]

(U) During the last 10 days of December officials from Headquarters USAF, AFSC, and ASD refined the continuation list. By 3 January 1964, they had divided the last revision into five categories, only three of which subsequently received any serious consideration. Category I included items which would advance technology, Category II items required only feasibility demonstration or design verification, and Category III comprised nearly completed hardware.

(U) After reviewing the list, the Air Staff on 7 January recommended to Dr. Flax reinstatement of the 38 tasks listed in the first three categories at a cost of $3.082 million and rescission of the $200,000 obligation ceiling.[12]

([redacted]) On 15 January Secretary Zuckert approved all but two of the tasks at an estimated cost of $2,817,700. AFSC was subsequently authorized to obligate funds and advised that the $200,000 monthly ceiling had been removed.[13] On 30 January Dr. Brown approved the actions taken by Secretary Zuckert and concurred in the rationale exercised by the Air Force in selecting projects for continuation.[14]

(U) By the end of February, all formal reporting and other management responsibilities of the Headquarters USAF X-20 program element monitor had either been completed or turned over to other offices and on 1 March the monitor activity ceased to exist. The Directorate of Procurement Policy thereafter handled all matters relating to contract termination. The Directorate of Science and Technology took over the task of reporting on and monitoring the continuation program.[15]

In Retrospect

(U) Although terminated about two years before its first scheduled orbital flight, Dyna-Soar produced considerable technical data, hardware, and expertise which were expected to benefit other undertakings and generally advance space technology. For example, many new or improved high temperature materials were developed and extensive data were compiled on their mechanical and physical properties, and on their processing and fabrication characteristics. These advances in materials technology were applicable to other large rocket boosters and spacecraft. An environmental control system also was developed which featured flight weight cryogenic subsystems. Upon completion of integrated system testing, a proven design was expected to be available for possible adaptation to future manned space systems.

(U) Evolution of the X-20 glider involved over 2,000 hours of wind tunnel testing at high mach numbers. Study and analysis of this test data increased knowledge of aerodynamic stability and control at hypersonic velocities, and the validity of analytical approaches to engineering design problems. The X-20 full [redacted] pressure suit features many improvements over the earlier suits worn by the X-15 pilots and Mercury astronauts, and the eight completed suits were transferred to other USAF and NASA space projects. Finally, the X-20's guidance subsystems--four fully and one partially completed--were immediately accepted by the Air Force for other space-oriented activities.[16]

IV. THE AIR FORCE ROLE IN NASA'S GEMINI PROGRAM

[redacted] On 21 January 1963 Secretary McNamara and Administrator Webb signed an agreement which provided, among other things, that the Air Force was to be represented on NASA's Gemini flights by a series of experiments. In accordance with the understanding, a Gemini Program Planning Board (G[redacted]as formed to assure that the scientific and operational experiments conducted on the Gemini flights met the requirements of both NASA and DOD. The board, which convened for the first time on 8 February, formed the NASA-DOD Ad Hoc Study Group to compare the objectives of the two agencies and recommend possible Defense Department experiments which might be included in the Gemini [redacted]s.

([redacted]) The board subsequently endorsed the work of the study group and on 29 May recommended to Webb and McNamara a series of 18 military experiments that cost approximately $16 million over a three-year period. On 20 June the Secretary of Defense approved the board's recommendations and authorized the Air Force to proceed with detailed planning.[1]

Planning Gemini Experiments (Program 631A)

([redacted]) The Air Force on 2 July 1963 submitted a program change proposal (PCP) to OSD based on the board's recommendations. Although such mission [redacted] areas as reconnaissance, satellite defense, and offensive weapons were studied, many of the USAF experiments centered about satellite inspection. As outlined by the Air Force, equipment contracts would be awarded in September 1963, the first experiment flown in October 1964; and the last in April 1967. The PCP specifically requested establishment of a program element and financing of the 1964 and 1965 requirements.[2]

[redacted] On 5 September OSD approved the request, established Program Element 6.34.09.25.4 to cover Gemini activities, and authorized funding levels

of $18.5 million in 1964, $6 million in 1965, and $2.1 million in 1966. Although the Air Force did not include it in its 2 July program change proposal, OS[redacted]dered modification of Titan II as the Gemini Launch Vehicle (GLV) as part of this program element and authorized $10.5 million for it out of the $18.5 million in 1964 funds.[3]

([redacted]) On 26 September AFSC forwarded to Headquarters USAF a technical development plan describing 13 USAF and 9 Navy experiments as well as the schedules and resources required to conduct them within the framework of the NASA program. The Army submitted no specific experiment, and its general requirements had already been anticipated by several USAF proposals.[4]

([redacted]) After being reviewed by the Air Staff, Under Secretary McMillan forwarded the development plan to DDR&E on 14 October and requested [redacted] of the 1964 funds on the schedule specified by AFSC. But because the DOD Gemini Experiments Program was considered an integral part of the whole military man-in-space question then under review, OSD did not immediately approve the plan. The Air Force met AFSC's initial fund needs by transferring $1,196,000 from Program 706.* These funds covered the cost of Aerospace Corporation technical direction and some definition, integration, and hardware studies for the earliest [redacted] of the planned experiments.[5]

([redacted]) By mid-December 1963, however, there was a clearly identified need for $3.9 million by early February 1964, which could not be obtained from Program 706 funds. The critical requirement was for $1,017,000 to cover Aerospace services for the rest of the year and hardware procurement and installation for Experiments 4 and 9.+ If the funds were not received by 7 January, NASA would be faced with the decision of either slipping the Gemini 4 spacecraft modification schedule or cancelling the two experiments.[6]

* This program is discussed in Chapter VII.
+ A list of experiments appears on p 36.

([redacted]) On 8 January 1964 Dr. Brown released $350,000 and on 13 J[redacted] the additional $667,000 for hardware. By this time, however, it was decided to incorporate the experiments into the fifth Gemini flight.* Pending submission of firm technical data (the September technical development plan (TDP) had been only preliminary in nature), DDR&E withheld the remainder of the USAF request. McMillan thereupon asked the Chief of Staff for an Air Staff position on the experiments in order to make an official presentation to DDR&E and the Gemini planning board. He also wanted the Air Staff to revalidate the experiments in light of the decision to develop the manned orbiting laboratory.[7]

([redacted]) As requested, the Air Staff promptly reexamined the planned experiments. On 13-15 January, Air Staff spokesmen briefed the Space Panel and Air Staff Board, noting that AFSC and Aerospace Corporation had decided th[redacted]he originally planned experiments were not worth the cost and spacecraft weight penalty and should be eliminated. On the other hand, a new experiment with an "Astronaut Chest Pack" had been added because it was a logical step for astronaut extra vehicular activity involving Gemini spacecraft. There was still some question about a proposed "Hybrid Infrared/Laser" experiment because it might involve certain technical and payload risks. Definitive studies for this experiment would not be completed until June. Otherwise, the Air Staff noted that the experimental program was essentially unchanged from that proposed in October 1963[redacted]r Staff Board concluded that the program, with the reservations about the laser experiment, should be presented to Under Secretary McMillan as a firm USAF position.[8]

* The first Gemini flight, the unmanned GT-1, was launched on 8 April 1964. The first manned Gemini flight, GT-3, did not take place until 23 March 1965.

(This page is C[redacted])

[redacted]

[redacted]

[redacted]) McMillan had also expressed some concern over possible funding overruns. In this respect, the Air Staff advised that the new cost estimate for the Gemini experiments was $17.28 million, an increase of about $1.1 million over the original estimate. The new figure included the $1.18 million withdrawn from Program 706 and other sources as well as a $2.1 million contingency for anticipated cost increases. The Air Staff recommended that, although fiscal year 1964 requirements were now estimated at only $6.02 million, the Air Force should proceed on the basis of the approved $8 million level because firm costs would not be available until March, and the trend was upward. The Air Staff also recommended that OSD release to the Air Force the 1964 outstanding balance of $6.983 million immediately rather than on a piecemeal basis.

[redacted] Secretary McMillan accepted the Air Staff views and on 15 January he and other USAF officials briefed Dr. Brown who informally concurred. After the Gemini planning board also reviewed the Air Force position, McMillan on 21 January asked DDR&E to accept the USAF report as a revision to the development plan and to release the remaining 1964 funds. On 22 January the Chief of Staff, confirming the Air Staff actions of the preceding week, formally approved the adjusted list of experiments as the USAF element of the DOD Gemini Experiments Program (Program 631A).[9]

[redacted] On 7 February Dr. Brown accepted McMillan's recommendations, approved the USAF Program 631A for fiscal year 1964, and released the remaining $6.983 million. At that point Program 631A, including the GLV modifications, was funded at $14.617 million for the year. The experiments portion now consisted of the following:[10]

USAF Experiments

D-1	Visual definition of objects in space
D-2	Target inspection modes
D-3	Mass determination

[redacted]

[redacted]

USAF Experiments

[redacted]

D-4	Passive infrared
D-5	Autonomous navigation
D-6	Visual definition of terrestrial features
D-7	Observation of launches
D-8	Radiation measurements
D-9	Autonomous navigation
D-10	Autonomous navigation
D-11	Astronaut extravehicular chest unit
D-12	Astronaut maneuvering unit
D-16	Astronaut extravehicular unit

USN Experiments

N-1	Astronaut visibility
N-3	UHF, VHF, polarization measurement
N-10	Lowlight level television

[redacted] Broken down by technical objectives, the experiments fell into several groups: (1) photo optical experiments (D-1, D-2, D-6): investigate man's ability to discriminate, acquire, track, and photograph selected orbital and terrestrial objects from the Gemini capsule; (2) Experiment D-3, Mass Determination: investigate the feasibility of a proposed direct contact method for mass determination; (3) radiometric experiments (D-4 and D-7): obtain spectral analysis information in selected targets--such as missiles launched from the earth--and sky and earth backgrounds over a broad portion of the optical spectrum for use in the design of improved sensing systems; (4) a radiation experiment (D-8): obtain data on the absorbed dose rate and total dose inside the Gemini capsule and to evaluate dosimeters; (5) autonomous navigation experiments (D-5, D-9, D-10): investigate methods of determining orbital elements, present and future spacecraft position, and the accuracy obtainable using on-board devices, as well as star occultation techniques and equipment and ion yaw sensors; and (6) astronaut extravehicular experiments (D-11, D-12, D-16): demonstrate man's ability to perform extravehicular activities using an attached environmental control unit and a controlled maneuver capability and space power tools.

[redacted]

[redacted]) The DOD program included three Navy experiments: (1) visibility experiment (N-1): determine man's ability to discriminate, acquire, track, and photograph selected terrestrial targets from an orbiting space vehicle; (2) Experiment N-3, polarization measurements: obtain precise measurements of the electron content and density of the ionosphere below the spacecraft, and the horizontal gradient of the electron distribution as a function of time and location in space; and (3) Experiment N-10, lowlight level television: obtain data on nighttime surveillance of the sea, cloud cover, cities, and ships at sea.

(U) At the end of fiscal year 1964, firm plans had been made to fly the first DOD experiments aboard Gemini 4 about April 1965. Subsequent flights through Gemini 10, to be scheduled at three-month intervals, would also carry DOD experiments. Experiments for Gemini 11 and 12 were under review at the end of the period.[11]

Gemini Launch Vehicle Development

[redacted] As noted above, OSD included modification and improvement of Titan II as the Gemini launch vehicle as part of Program 631A. Almost two years before, in December 1961, NASA and DOD had agreed that the Air Force would provide Titan II boosters for Gemini. By March 1963 it had become apparent that the Titan II would have to be modified or adjusted to be acceptable for launching a manned system. Major problems included second-stage combustion instability, longitudinal oscillations during first-stage burn, and general engine imperfections.[12]

[redacted] On 29 March 1963 McMillan and representatives of NASA, AFSC, and the contractors reviewed corrective steps for man-rating the booster. They identified a basic $20.13 million effort, excluding possible procurement of additional boosters for test purposes. The first-stage longitudinal osciallation correction effort, estimated to cost $2.43 million, would have four elements--engine

[redacted]

transfer functions, turbo pump assembly characteristics, impeller design, and suction line hydrodynamics. The second-stage engine combustion problem would require an estimated $3.7 million to resolve. The third phase covered product improvement, updating actions normal to any ICBM after it emerged from development. It was anticipated that this would cost $9 million, exclusive of $5 million worth of propellants.[13]

(Secret) Following the above review, AFSC immediately authorized the system project officer to use Titan II funds to correct the oscillation. The command also confirmed that tests to define the combustion instability problem were under way and that $1.6 million in Titan II funds was earmarked for this purpose. On 5 April AFSC completed a Titan II-GLV development plan incorporating these actions and the guidance emanating from the 29 March meeting. The plan was presented on 6 May to the Gemini planning board, which approved it with minor revisions.

(Secret) On 20 June 1963 McNamara accepted the board's overall recommendations, authorized $29.1 million, and directed the Air Force to develop a Titan II improved engine test plan.[14] On 19 July, during a Designated Systems Management Group (DSMG) meeting, McMillan directed AFSC to expedite preparation of such a plan that would satisfy both military and GLV requirements.[15]

(Secret) The AFSC plan, completed at the end of July, was subsequently reviewed by the board structure and coordinated with NASA both at the working level and at a Gemini planning board meeting on 5 August. After presentation of the plan to the DSMG, Secretary Zuckert submitted it to Secretary McNamara on the 23d. He advised the Defense Secretary that the plan was essentially the same in technical content as the one approved by the board in May. The major difference was that it reflected the impact of the Titan II engine improvement effort, as well as Titan II's planned use as the core of Titan III and as the Gemini booster.[16]

Zuckert asked McNamara to approve the plan and to release funds.

(S) On 6 September DDR&E authorized engine improvement and transferred $4.9 million from the Gemini program element to the Titan program for this purpose. It also directed the Air Force to submit by 1 October a PCP on the recommended financial reprogramming required to provide the other funds. In addition, it requested the Air Force, before proceeding with ground tests, to submit an integrated plan defining the GLV configuration and an associated flight test plan. The OSD comptroller released only $1.9 million of the $4.9 million immediately, but this had little impact, since on 8 January 1964 Dr. Brown was able to release the balance of funds.[17]

(S) In the meantime, there had been a minor difficulty in agreeing on GLV technical specifications. The problem was really one of semantics and the Air Force desire to avoid being pinned down to possibly unattainable "criteria" rather than desirable "objectives." At any rate, Seamans and McMillan, as co-chairman of the Gemini planning board, reached a satisfactory understanding during an exchange of correspondence in late November. In a memorandum of understanding signed during the first few days of December, they stipulated that NASA's stated requirements were reasonable and that the USAF plan to eliminate the problem areas appeared technically feasible and should result in a satisfactory GLV. As a safety valve for the Air Force, the agreement provided that in the event certain goals were found to be unattainable under the plan, the entire subject would be jointly reviewed by NASA and DOD to determine a course of action.[18]

(U) Subsequently, after it had been reviewed and revised, McMillan approved AFSC's expanded GLV stage II engine combustion stability development plan, as presented to him on 17 March. On 6 April he furnished copies to DDR&E and announced his intention to submit it to the Gemini planning board at its next meeting.

Meanwhile, the Air Force had reprogrammed funds to support the work through mid-April and was preparing a request to cover the rest of 1964.[19]

(U) By January 1964 the longitudinal oscillation problem was resolved to the satisfaction of NASA and the Air Force, after the third consecutive test flight showed that newly installed fuel accumulator and oxydizer surge chamber hardware had consistently reduced the movements to an acceptable level.[20] The first Gemini launch vehicle, GLV-1, which the Air Force had accepted from the Martin Company on 25 October 1963, successfully orbited a boilerplate Gemini spacecraft on 8 April. Performance of all systems was satisfactory, it put the spacecraft load into the planned orbit and, of major interest, the oscillation at the interface of GLV-1 and the capsule was 0.16 g's.

(U) By the end of April both the Air Force and NASA were satisfied that not only the oscillation difficulty had been effectively corrected, but that the combustion stability and engine improvement projects were proceeding satisfactorily. On 20 April, during a Gemini planning board meeting, Dr. Seamans commended the Air Force for the progress that it had made in man-rating the Titan II.[21]

A Look Ahead to Apollo

(U) In May 1964, with the military experiments for Gemini defined and work under way to provide needed equipment, NASA brought up the question of DOD participation in the Apollo manned circumlunar flights and lunar landings. On 18 May Dr. Seamans suggested to Brown that the Defense Department might wish to participate in the on-board experiments phase of the mcon project in the same manner as in Gemini. Expressing the hope that it would, Seamans noted that time was already becoming critical. Full data on experiments that DOD might propose for the earliest available Saturn IB launchings would have to be presented by 1 October.[22]

(U) Dr. Brown was interested and asked the Air Force to study the matter. At year's end, both the Air Staff and AFSC were identifying suitable piggyback experiments which might be flown during the near-earth phase of Apollo.[23]

V. TITAN III

([redacted]) During fiscal year 1964 Titan III development, which General Schriever, the AFSC commander, considered "one of the best managed programs in DOD," continued to progress in a highly satisfactory manner. All technical contractors were on schedule in fabricating and testing major components. Facilities construction--despite labor troubles, bad weather, and the bankruptcy of one contractor--nevertheless was generally on schedule.

([redacted]) The most important problem which emerged during the year was the lack of identifiable payloads for the period after the end of flight test launchings. The payload question became especially critical after Dyna-Soar's termination. In fact, where it had once been said of Dyna-Soar that it was "a vehicle looking for a mission," an apt description of Titan III toward the end of fiscal year 1964 might have been "a booster looking for a payload." Timely resolution of this problem was essential to maintain the industrial expertise and resources built up during the engineering and production of the initial boosters.

Development Progress

([redacted]) During July-December 1963 fabrication of Titan III components and ground support equipment continued essentially in accordance with the master schedule established in 1962. In July two significant milestones were passed. On the 20th a full-scale, five-segment pre-prototype solid motor was successfully tested in a static firing at the United Technology Center* plant in Sunnyvale, Calif. The motor produced the predicted one million pounds of thrust, meeting all test objectives.[1] Three days later, at Azusa, Calif., the Aerojet General Corporation completed a long duration firing test of the upper stage (transtage) engine. After one faulty start and automatic shutdown because of an erroneous instrument reading,

*Prior to 1 December 1962, United Technology Center had been known as the United Technology Corporation.

the liquid fuel transtage engine ran as planned for a total of 4 minutes and 48 seconds with two programmed shutdowns and restarts.[2]

(U) Assembly of the structural parts and tankage for the first core vehicle was completed at the Martin plant early in 1964. With acceptance of the first modified guidance system from A. C. Spark Plug and the engines for all three liquid stages from Aerojet General, the first flight vehicle became available on schedule in the spring of 1964. By 25 June all combined system tests of the first Titan III core were completed on or ahead of schedule. Meantime, in early January and on 26 March the second and third static firing tests of the solid motors had been successfully conducted at Sunnyvale.[3]

[redacted] The sole major technical problem, one that might become the pacing factor in the ability of the Titan III to meet its technical objectives, involved Aerojet General's transtage engine, which began to exhibit low performance and questionable durability. The Air Force and Aerojet General cooperated in a series of managerial and technical efforts to solve the problem. In addition to this "get well" effort, the Air Force sought industry proposals on an alternate transtage engine from six rocket engine manufacturers. Five responded, but none appeared any more promising than Aerojet General's, and on 9 June SSD was advised that there would be no new award on the transtage engines.[4]

[redacted] Construction of two solid motor static test stands at Edwards AFB, Calif., --delayed successively by weather, a jurisdictional labor dispute, and bankruptcy of the original prime contractor--was not completed until 17 September. This considerably delayed installation and checkout of the facilities' test stand instrumentation which tasks were not completed until 10 February, two months behind schedule. Its impact on the overall program, however, was not severe.[5]

[redacted] Unfortunately, the Edwards test program suffered a severe setback on 2 May 1964, the day Maj. Gen. Ben I. Funk, SSD commander , was dedicating the facility. The feature of the ceremonies, witnessed by scores of government and industry officials as well as news media representatives, was to have been the fourth firing of a 120-inch solid motor. However, one minute after ignition the rocket motor exploded, inflicting great damage to the stand that General Funk had just described as "the most sophisticated and highly instrumented facility in the world." [6]

(U) An AFSC review board attributed the explosion to an insulation burnthrough due to "unsatisfactory techniques utilized in the installation of the segment insulation." Cleanup and restoration of the test stand, at a cost of about $1.22 million, began immediately. Officials estimated that testing at Edwards AFB would be delayed about 75 days. However, United Technology Center's facilities were available for testing and no launch schedule slippage was expected because of the accident. [7]

(U) By the end of fiscal year 1964, Titan III construction at Cape Kennedy was essentially on schedule. Modification of Pad 20, a Titan II site, as the Titan IIIA facility, was completed on 16 September. Construction of the new pads 40 and 41 for the Titan IIIC began on 26 June. Construction of all other facilities in the complex, including the vertical integration building, the solid motor assembly building, the rail system, and the necessary support facilities, began 9 August.

(U) The only problem foreseen at the Cape at the end of the year was the effect of a new labor dispute. On 8 June maintenance workers of the Florida East Coast Railway went on strike to protest operation of a Government-owned railroad spur by non-union personnel. A temporary injunction was placed against them on 11 June and a permanent injunction on 18 June pending the outcome of the National Labor Relations Board hearings on the issue. AFSC estimated a 30-percent reduction in the work force on pads 40 and 41 should the union reinstate its pickets. [8]

(U) In the meantime, the Air Force sought to acquire a Titan III complex at Vandenberg AFB that would allow polar-orbit launchings, a capability of great military importance. On 5 December the Secretary of Defense approved a USAF request to include funds in the fiscal year 1965 Titan III program for land acquisition and initial site improvement at Vandenberg. Congress, however, disapproved, and Air Force hopes were at least temporarily dashed.[9]

Titan III Funding

(U) On 2 July 1963 McMillan forwarded to OSD a revised Titan III program change proposal which, for the most part, merely updated financial requirements. In it, the Air Force requested return of the $45 million loaned to the Minuteman program in fiscal year 1963 and an increase of $40 million in 1965 and $20.6 million in 1966 to serve as a contingency fund. In his response to McNamara's "Eight Questions" in the spring of 1963, Secretary Zuckert had pointed out that Titan III was austerely funded with no provisions for the unforeseen.[10] OSD replied on 14 November by re-allocating the $45 million, but denied the other requested funds. Deputy Secretary Gilpatric, while acknowledging that approved funding did not provide for contingencies, felt the additional money was not justified at the time. Should emergencies arise, he said, OSD would respond to specific needs.[11]

(U) In mid-December the Air Staff published a new Titan III system program directive. Like the July PCP, its primary purpose was to reflect revised funding and management decisions made since publication of the original directive in October 1962. It also asked AFSC to update the October 1962 system package program (SPP) to include progress achieved to date, major developmental and qualification ground test milestones, payload weight-in-orbit performance estimates, generalized test objectives, and expected production and operating costs after

completion of development. AFSC should assume alternative launching rates of 9, 12, and 24 per year for the two Titan II configurations, "A" and "C."[12]

([redacted]) AFSC completed the new system package program on 31 [redacted], and the Titan III System Project Officer, Brig. Gen. Joseph G. Bleymaier, briefed the Space Panel, the Air Staff Board, and the DSMG between 9 and 13 March. He foresaw no funding or technical difficulties that could not be solved. However, there were several problems that were beyond his level of authority to resolve. One was the disapproval of the west coast facilities, essential to any USAF hopes for a militarily operational system. The other was the lack of authority to train USAF personnel in the operation of the system. Bleymaier urged the Air Staff to press for favorable decisions on these questions in the near future.[13]

The Search for New Payloads

([redacted]4) Another important problem revolved around the question of Titan III production after completion of development. The contractors were working at a very high level of effort which would soon begin to taper off. As the end of flight tests neared in 1966, it would drop off drastically if no follow-on production were authorized. The Air Force felt it important to identify and contract for production as early as possible so the contractors could retain their experienced and skilled personnel. Any lag would cause a dissipation of this unique pool of talent with a resultant delay in future production.[14]

([redacted]) The key to the problem was identification of payloads. The immediately foreseen user of the booster was Dyna-Soar, scheduled for a series of 10 test launchings through 1968. It was presumed thereafter that Dyna-Soar, whether retaining its development status or being reoriented toward a more operational concept, would require additional boosters each year. In addition, the Air Force believed that the newly reoriented DOD communication satellite effort would require

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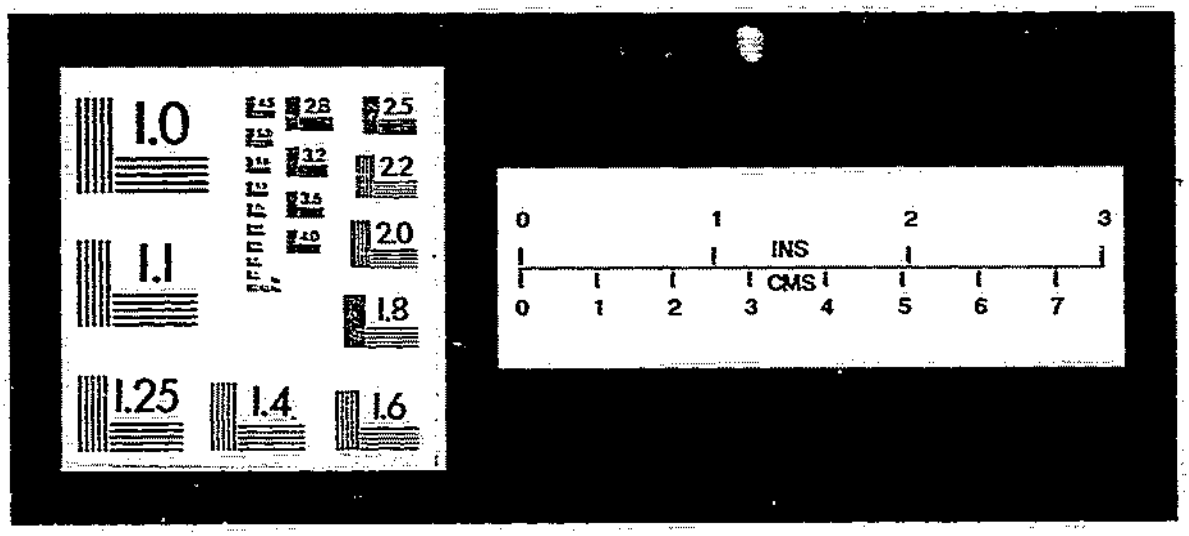
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Titan III boosters in 1965. Beyond these defense payloads, the Air Force felt that a number of NASA programs would also require the booster.

(S) By the spring of 1964 the payload picture had changed considerably. Dyna-Soar had been cancelled and OSD's caution in initiating a definition phase for the Program 369 medium altitude, communication satellite put off the need for a booster for it until mid-1966 at the most optimistic estimate. Likewise, OSD's decision to delay the synchronous orbit version (Program 814) until it wad decided whether the civilian Communications Satellite Corporation could meet DOD needs, obviated any immediate booster requirements.

(S) Also, at this point, although the Air Force had convinced itself that NASA could not get along without Titan III, the space agency was talking of using its highly reliable Saturn vehicle or another modification of the Titan II featuring a high energy upper stage. Only toward the end of the fiscal year did NASA actively examine the possibilities of Titan III for its Surveyor project. The recent MOL decision was considered of no immediate help to the Air Force because the laboratory was not scheduled for launching until 1968. As matters stood in March 1964, Titan III development would end in June 1966. Thereafter, there might be some Program 369 communication satellite payloads and NASA might use the booster, although it had made no commitment.

(U) The payload problem was not, however, completely new to the Air Force. Dr. Flax had begun to investigate one aspect of the subject as early as August 1963, at a time when hardware and construction aspects of Titan III development were well in hand. The Assistant Secretary thought it appropriate to consider payloads other than Dyna-Soar that might be accommodated during the 17-launch test series. He therefore asked General Ferguson for his views on the matter along with a proposed list of payloads.[15]

[redacted] In his response, Ferguson assured Dr. Flax that the Air Staff and AFSC were working on the matter but pointed out that it was premature to expect definite payload commitments. At any rate, Maj. Gen. R. D. Curtin, Director of Development Plans, analyzed the nature of the test launching and indicated the payload constraints of each. For all practical purposes, only the five A configuration launch profiles would prevent incorporation of payloads because of the severe flight maneuvers that were planned. With respect to the "C" launches, Curtin stated that there should be little if any payload limitations other than those imposed by weight and type of orbit required. Among potential payloads he listed for Titan III test vehicles were Dyna-Soar, communication satellites, tracking system packages, gravity gradient satellite experiments, a variety of scientific packages prepared by the Air Force Cambridge Research Laboratories, Program 823, and unmanned Gemini capsules.[16]

[redacted] The above information, based in part on an AFSC follow-on production plan informally briefed to the Air Staff on 20 August, was forwarded to Dr. Flax the next day. AFSC formally submitted the plan shortly after. It proposed funding Titan III in fiscal year 1965 at $125 million, which included $11 million for certain "one time" expenditures plus the costs of supporting a production rate of two boosters a month. The AFSC plan envisioned that after the first year, support would be in the nature of a revolving fund, being replenished by the sale of vehicles to users, and emulating, for example, the Military Air Transport Service's Airlift Industrial Fund. However, since the plan could not identify agencies which would employ the vehicle, it seemed unrealistic to establish a procurement system based on user requirements.[17]

[redacted] AFSC proposed a production rate of 24 a year, to follow the development version without a break. The AFSC plan provoked considerable disagreement when the Air Staff began coordinating it on 6 September. The major issue was the production rate. Some agencies thought it unrealistically high and urged withholding

[redacted]

the plan from OSD until the Air Force could submit a firm proposal. Others recommended forwarding the plan to DDR&E, less some controversial sections, in order to obtain needed funding. To resolve these differences, representatives of several Air Staff offices and AFSC met on 15 October. They concluded that the best approach would be to send the plan to DDR&E, but to indicate in the covering correspondence a possible alternate annual production rate of nine boosters.[18]

[redacted] After the Air Staff had acquired more information from AFSC on which to base alternate proposals, Secretary Flax forwarded the August plan to DDR&E as a preliminary planning document. He advised that the Air Force would submit a definitive proposal when it had completed its analysis of launch requirements and cost estimates. He pointed out that the assumed rate of 24 a year was based primarily upon production considerations, not expected launch rates, and was picked as best in terms of low cost per vehicle. An increase would require new production facilities (at additional government cost), while a decrease would result in production of some components on a lot basis rather than continuous production.[19]

[redacted] Dr. Flax noted that the proposed lead times would require funding in 1965-66 to deliver boosters for launchings early in fiscal year 1967. Preliminary estimates for production of 24 a year were $136 million for 1965 and $225 million for 1966. At the 9-per-year rate, which Dr. Flax offered as an alternative and which was comparable to current development procurement, the estimates were $56 million in 1965 and $100 million in 1966. Although AFSC had urged support of the 24-per-year figure, Dr. Flax recommended DDR&E acceptance of the lower figure, because of the planned launch rates for 1965-1966, and release of remaining fiscal year 1964 funds. On 20 December Dr. Brown approved the recommended program and released the funds, bringing the total made available during the year to $324.6 million.[20]

(S) In the meantime, the Air Staff and AFSC had continued to study the matter of users for Titan III flight test boosters. By 1 October AFSC had developed a list of payload constraints, generally intended to assure that the 17 launchings would prove the booster's reliability. During October AFSC and SSD advised NASA, the Advanced Research Projects Agency (ARPA), the Office of Aerospace Research (OAR), and others of the possibility of utilizing certain of these Titan III's to carry other payloads. By early spring, however, only two series of experiments had been identified as probable payloads, one proposed by the Lincoln Laboratories of the Massachusetts Institute of Technology, and one by OAR.[21]

(S) During the last half of the fiscal year, the Air Force and NASA gave serious consideration to launching Surveyor satellites using Titan III development boosters and subsequently production models. Surveyor, NASA's unmanned lunar soft-landing spacecraft, had been scheduled for first flight in 1965 using the Atlas-Centaur combination. However, NASA was interested in increasing the Surveyor instrumentation payload in 1967 and 1968. Among the options open to it was the Titan III-Centaur combination. AFSC estimated, on the basis of 20 boosters a year, the cost to NASA would be $12.8 million a launch. At the end of the fiscal year NASA's Lewis Research Center, assisted by the Air Force, was completing a formal and detailed review of the problems and benefits associated with this proposal.[22]

Consideration of the Titan IIIX Possibility

(U) The general lack of customers for the Titan III boosters forced the Air Force to approach the problem from still another direction. By the end of the fiscal year it was seriously considering a stripped down version of the Titan IIIA, called Titan IIIX,* designed to compete with the Atlas-Agena for payloads. The Titan IIIA was to have the capability to place into 100-mile polar orbits payloads

* A little earlier, some Air Force documents referred to this as the Titan IIIZ.

[redacted]

weighing 3,731 pounds. By proper propellant conditioning and utilization as well as trajectory shaping, it was thought the booster could orbit up to 4,410 pounds. However, this weight was still below that of the largest number of projected payloads and might not even be attained if transtage propulsion did not improve. Additionally, the high cost associated with man-rating all Titan IIIA components prevented the booster from being competitive for a large number of unmanned missions. Consequently, the Titan III System Program Office proposed and briefed Drs. Flax, McMillan, and Hall on a Titan IIIX configuration that would involve removal of certain elements of the A vehicle as well as a number of other changes.[23] At year's end, this proposal was under review.

[redacted]

VI. PROGRAM 461

([redacted]) For several years the Air Force had been trying to acquire a space-based sensor system which, in combination with ground devices, would provide credible and timely warning of an enemy ICBM attack. By 1963 this effort was centered on Program 461, which involved launching polar-orbiting satellites with infrared sensors to scan the earth continuously and detect ICBM's within minutes of their liftoff. Although the Air Force believed it had proved the value of reliable early warning against missile attack and the potential contribution of Program 461, during fiscal year 1963 OSD had cut it back to $75 million for 1963 and $35 million for 1964 and directed the Air Force to reorient the project as a purely development effort with no operational connotations.[1]

Satellite Performance Vindicates the Air Force

([redacted]) In May 1963, just when Program 461 had reached its lowest ebb, its promise and reputation were salvaged. Early that month Congressional [redacted] had questioned the competence of both the Air Force and its prime contractor, the Lockheed Missile and Space Company, to manage this kind of space project. However, on 9 May a Program 461 flight sequence began which completely vindicated all that the Air Force and Lockheed had ever said about the infrared system. On that day Flight Test Vehicle (FTV) 1206 was launched aboard an Atlas/Agena from Vandenberg AFB and injected into a near perfect circular orbit at an altitude of 2,000 miles. During the satellite's six weeks of productive orbital life, it detected nine launches of U.S. ICBM's, including several solid fueled Minuteman and Polaris missiles as well as the liquid fueled Titan and Atlas missiles.[2]

([redacted]) Readout data unequivocally established the actual detection of each of these launches. The Atlas E, Minuteman, and Titan II detections were

witnessed on real time display. Because the Program 461 payload was designed to detect liquid fueled targets of much higher radiance and longer burning time than solid fueled missiles, confirmation of the Polaris sighting required additional data analysis. However, it had no difficulty detecting Minuteman missiles which had a longer burning time. For that matter, the Air Force believed that solution of the real time readout of a Polaris type launch would not present a serious technological problem.

(S [redacted] 4) The next flight test vehicle (FTV 1204) failed because of a booster malfunction on 12 June, but FTV 1207 achieved a proper orbit on 18 July. It operated satisfactorily through 96 orbits but began tumbling on the 97th so that it could no longer perform its detection task. Nevertheless, the satellite not only detected in real time the only launch during its orbital period, an Atlas E on 26 July, but it also succeeded in acquiring data about Soviet missile activity.[3]

([redacted] 1) The successes of FTV's 1206 and 1207 confirmed Air Force faith in Program 461. The experiments verified that earth background phenomena would not interfere with the real-time detection of ballistic missile launchings.* Equally important, the successful repetition of the 461 experiments greatly increased confidence that spaceborne systems could be used for military and peacetime surveillance. Consequently, Secretary Zuckert urged OSD to reappraise Program 461. DDR&E in late June requested another review of the project in light of the new data, and Secretary McNamara asked the JCS to again evaluate the uses of tactical warning, particularly Program 461.[4]

The Air Staff Proposal

([redacted] The Air Force eagerly responded to DDR&E's invitation to reopen the question of an appropriate 461 Program. By late September Headquarters USAF

* Critics of Program 461 had long pointed to the background problem as a major weakness of the system.

was considering a revised AFSC plan which listed four alternative approaches to achieving an operational system. The Air Defense Panel, meeting on 23 September, rejected all four and recommended a fifth alternative which it described as an expanded flexible prototype approach. The Air Staff Board endorsed the panel action. It took the position that OSD was not amenable to expanding the nature and objectives of the project but that neither the existing technology nor finances would support a completely operational system.[5]

([redacted]) In adopting the fifth alternative, which called for a developmental effort from which there would also be some immediate operational benefits, the Air Staff considered four major factors: cost effectiveness, the need for continued research and development, the potential of development satellites to provide fallout operational data, and the possibility of extending the 461 system to perform missions other than missile detection. With these in mind, the Air Staff identified a number of objectives to guide the 461 effort. First, it proposed AFSC seek to improve the ability of the satellite to track and locate missile launchings and identify launch sites precisely. AFSC also was to measurement and evaluation of earth background phenomena to confirm and increase existing knowledge.[6]

([redacted]) The board also felt AFSC should emphasize advanced detector technology with particular reference to increasing the system's ability to detect [redacted] low radiance, short burning solid fuel missiles in real time. It suggested cost effectiveness could be enhanced by developing a simplified and highly reliable spacecraft and payloads with long orbital lifetimes and by use of higher altitudes which would require fewer satellites to provide the required coverage. Finally, it proposed that AFSC study ways to apply to significant military tasks the by-products of the experimental satellites in the area of technical intelligence and other defense applications.

[redacted] On 1 October, following a board presentation to the Air Force Council, the Chief of Staff approved the fifth alternative approach and a 461 program comprising three series of satellite flight tests. Six Discoverer Radiometric (DRM) launches were programmed in 1964-1965, seven Detection Test Series (DTS) flights were to be spread over the years 1966-1970, and eight Research Test Series (RTS) flights were programmed for 1967-1969. Fiscal year 1965 costs were estimated at $100 million.

[redacted] Assistant Secretary Flax was in basic agreement [redacted] Staff's recommendation, feeling it was preferable to the AFSC proposals. However, because of financial restraints, he recommended elimination of one RTS flight and adjusting schedules to reduce 1965 funding to $75 million. Fiscal year 1964 funding would remain at $35 million. Secretary Zuckert accepted this adjusted proposal and on 22 October 1963 forwarded it to the Secretary of Defense. In doing so, he reaffirmed the validity of conclusions of previous USAF studies on the importance of early warning and the potential contributions of Program 461. He urged project approval. The JCS, meanwhile--after being briefed on the USAF plan--on 29 October 1963 unanimously endorsed 461 continuation and so advised Secretary McNamara.[7]

[redacted]

Project Reorientation

[redacted] Almost immediately after submission of the new proposal, the project was again reoriented on the basis of informal guidance from Dr. Brown. On 7 November he told Dr. Flax that developments of the past six months, i.e., the successful flights and analyses of their results, had made it clear that no additional Discoverer radiometric flights were required. Consequently, pending a final decision on objectives and funding level of a reoriented Program 461, he asked that the effort devoted to the radiometric series of flights be diverted into

a detection payload which could attain a capability against submarine launched ballistic missiles (SLBM's) and medium range ballistic missiles (MRBM's).[8]

([redacted]) Several weeks later, Program 461 suffered a sharp setback when OSD on 26 November reduced its 1965 funding level to $10 million. After some informal discussion with DDR&E officials, Headquarters USAF on 12 December asked AFSC to evaluate the impact of the reduction. The command was told to assume 1964 funding of $35 million and $10 million in 1965, but was also to anticipate appreciable increases in subsequent years.[9]

([redacted]) On 14 January Dr. Brown released $9 million in 1964 funds to the program--about half of the 1964 money which had been deferred. He continued to withhold the remaining $8.5 million pending the Air Force's submission of a revised program plan to his office in February.[10] The following day Dr. Brown took some pains to explain the rationale underlying a new decision to reduce the 1965 program to $8.9 million ($1.1 million was withdrawn to establish a new line item, "Satellite tracking and control"). Brown knew this constituted a "drastic reduction" of the USAF request; therefore, he thought it worthwhile to explain in some detail the basic considerations concerning it.[11] [redacted]

([redacted]) Brown noted the "outstanding" Air Force adherence to previous OSD guidelines, particularly its sincere effort to place Program 461 in the context of other early warning means, actual and potential. However, he added that it was the very existence of these alternate means which, when combined with the estimated costs of 461 deployment, had led to the low funding support of 461 in recent years. Now, however, the success of the 1963 flights and the recent technical review conducted by DDR&E and the Air Force had brought out very clearly the potential value of Program 461. He suggested that in addition to its tactical early warning function, Program 461 ought to aim at four key objectives. These were: launch point determination; detection in real time of

nuclear detonations, nth country launches, and submarine launched and medium range missiles; worldwide coverage; and reliability.

([redacted]) Dr. Brown observed that these multiple objectives represented a major departure from either the single system development to detect a mass raid of Soviet ICBM's or a program designed solely to gather research information for that application. They constituted a prime reason for funding the 1965 program at such a low level and would permit orderly project transition. He asked the Air Force to revise its program on the basis of the objectives he had outlined. It was to initiate design and component efforts leading to the most reliable possible vehicle. With respect to the three flights the Air Force had previously planned for calendar year 1965, in which it had already invested substantial money and effort, Brown urged it to attempt to use them in light of the reduced funding. He added that the Air Force might assume funding support in 1966 of $50 million and $100 million in 1967 in preparing a new development plan. However, he stipulated that this should not be construed as either an approval or a prediction of such funding levels.

([redacted]) After analyzing the impact of the reduced funding for 1965, the Air Force was very apprehensive about the project's future. Among other results, the lack of funds would preclude continuation of the approved RTS series and the proposed DTS series of flights, which would mean an approximate four-year gap between launches. It would necessitate terminating the majority of the existing contracts with corresponding closing costs. There also would probably be a slippage of some 18-24 months in attainment of project objectives. Of major concern to the Air Force was the fact that cancellation of the three 1965 launches would mean an investment loss of $40 million.[12]

([redacted]) On 5 March Dr. Flax proposed an alternate program which, he told Dr. Brown, would maintain the 1965 funding level at a minimum figure,

preserve the current investment, take advantage of the technological progress to date, and prosecute the objectives on a sounder development basis. With respect to the last point, Flax emphasized that this alternative would retain the important reliability objectives, while any program based on Brown's proposed $10 million ceiling, with its lack of spacecraft orbital launches, would deal a severe blow to such goals. The USAF counterproposal would retain the Research Test Series launches and their technical objectives but accept some slippage. It would require $26.9 million in 1965, an increase of $18.9 million, but would avoid termination and retain a reduced but acceptable industrial base during 1965.[13]

([redacted]) On 18 March Dr. Brown conceded that the USAF proposal would be a lower risk and, on technical merit alone, was preferable to his proposal. However, OSD was still restricted by financial limitations, and the USAF proposal involved a significant departure from approved funding levels. He advised that he could make no decision until the final level of appropriations was established and OSD knew what other projects would be affected if additional funds were allocated to Program 461. Therefore, the question could not be resolved until apportionment time.[14]

([redacted]) In the meantime, however, Brown wanted the Air Force option kept open and no cancellation action taken to preclude its ultimate choice. Toward that end, and apparently believing that something could be done during apportionment, Dr. Brown asked the Air Force to prepare a development plan and PCP based on its 5 March proposal. At the same time, since the USAF plan had satisfied OSD's requirements for additional information, he released the rest of Program 461's 1964 funds to the Air Force.[15]

([redacted]) At year's end, Secretary Zuckert forwarded the new program documents to DDR&E for approval. The objectives given were precisely those

of Brown's 15 January memorandum and the Air Staff's rationale of September. It was a minimal program based on already incurred investments and aimed at preserving both near- and long-term reoriented objectives, but with some slippage in schedule and an increased technical risk.[16]

([redacted] 4) Basically, the revised program was to consist of two overlapping phases. During the first phase, the Air Force would conduct 11 research test launches in three series. The first series was to begin in January 1966 and the last would end in calendar year 1970. This phase would be followed by seven development test launches, which in addition to achieving the reliability goals of one-year MTBF (meantime before failure), were to provide a useful warning capability. The satellites were to have the following capabilities and characteristics:[17]

RTS-1 - Launched between January and May 1966, these satellites were to be boosted into a 2,000-mile altitude orbit by Atlas-Agena and were to have a capability to detect SLBM's and MRBM's. During their six months of life, they were also to exercise a limited radiometric capability and a launch point determination of approximately 8-10 miles.

DTS-1 - Launched between January 1967 and April 1968, these satellites would perform essentially as the RTS-1 vehicles, but would have a quasi-operational status. They would demonstrate a full-year MTBF capability and furnish data to a readout station at Fort Greeley, Alaska. They would provide approximately 20-25 percent coverage of areas of interest and a degree of technical intelligence and warning, in addition to giving the Air Force some operational experience with such a system.

RTS-2 - Launched between January and July 1968, these Research Test Series satellites would be put into orbit at 6,000 miles by an improved Atlas-Agena. They would provide SLBM-MRBM detection and demonstrate improved launch

point determination, on-board data processing, nine months' life, altitude control, and isotope power.

DTS-2 - To be put into orbit between March and November 1969 by whatever competent boosters were available--probably Titan III--the DTS-2 satellites were to incorporate improvements demonstrated by the RTS-2 series.

RTS-3 - During the first seven months of 1970, this series was to be orbited at 6,500 miles to exercise a one-year life, a launch point determination of 2-4 miles, a definite SLBM-MRBM detection capability, a satellite-to-satellite communication link test, advanced isotope power, and advanced altitude control.

(U) Although no formal DDR&E response had been received by the end of June 1964, USAF officials--on the basis of Dr. Brown's 18 March paper and informal discussions with DDR&E personnel--were reasonably confident that the reoriented 461 project would be approved and funded essentially as outlined in the Air Force program change proposal.

[redacted]

VII. AIR FORCE ANTISATELLITE SYSTEMS

(S-Gp-4) During the previous fiscal year Soviet manned space exploits--the August 1962 tandem flights of Vostoks III and IV and the June 1963 84-orbit flight of Vostok V and 49-orbit flight of Vostok VI, the latter carrying the world's first female astronaut--had reemphasized Moscow's progress toward acquiring a significant capability to operate in the near-earth environment. These Russian successes suggested an ability to place offensive weapons into space and in turn caused the Defense Department to accelerate work on antisatellite systems. Program 437 was initiated to give the United States an interim capability, while work on another USAF system--begun several years before under Program 706--was reoriented to emphasize the satellite inspection mission.

Program 437

(S-Gp-4) During 1963 the Secretary of Defense had approved interim Program 437 which he wished the Air Force to have operational by June 1964. It featured the use of Thor missiles armed with 1.5-megaton thermonuclear warheads launched by USAF crews from Johnston Island to intercept hostile satellites. The warhead would be detonated from the ground by an AEC-developed weapon discrete burst command system.[1]

(S-Gp-4) As approved by Secretary McNamara on 27 June 1963, Program 437 was a bit more operationally oriented than the USAF development plan of April 1963 had proposed. Consequently, the Air Force undertook to revise its system program package. The new document, completed by AFSC on 21 August 1963, was approved by Secretary Zuckert on 25 September and forwarded to OSD on 4 October. Among other things, it called for increasing the strength of the 6595th Aerospace Test Squadron at Vandenberg AFB to 468 people. Of these, a detachment of 79 would

[redacted]

be stationed permanently on the island and 389 at Vandenberg. Operational complements of 108 men would rotate to the island for 90-day temporary duty tours.[2]

(S Gp 4) On 2 December McNamara approved the package essentially as submitted by the Air Force except that he reduced the proposed missile buy from 20 to 12. Four missiles were to be expended during a research and development demonstration phase (Phase I), four would become unit equipment, and four would be used as crew training vehicles. Funding was approved at $60 million in 1964, $12.1 million, $8.9 million, and $8.5 million in successive years.[3]

(S Gp 4) With approval and funds in hand, the Air Force made rapid progress in achieving Phase I objectives during the remainder of the year. Three highly successful demonstration launches--on 15 February, 2 March, and 22 April 1964--provided the necessary system data and confirmed missile accuracy, and a fourth launch on 29 May demonstrated "blue suit" operational proficiency.[4] The May exercise was somewhat marred when an electrical system malfunction caused the booster to deviate slightly from its intended trajectory. Nevertheless, the Commander, Air Defense Command (ADC), decided that the Air Force crew had professionally exercised all aspects of the system and that the demonstration was adequate. He accepted the system from AFSC, the Continental Air Defense Command assumed operational command, and the initial operational capability was concurrently declared, thus meeting Secretary McNamara's objectives.[5]

(S [redacted]) This interim operational capability provided the United States at least twice daily an opportunity to intercept any satellite below an altitude of 700 miles. System reaction, limited by the target tracking time needed to acquire sufficiently accurate satellite position data, was between 24 and 36 hours.[6]

Program 706

(S Gp 4) In its third year of development during 1963, the 706 program had encountered severe difficulties, not the least of which was overambitious objectives.

The Air Force had pursued development of a satellite negation capability in addition to more basic interception and inspection techniques. However, DDR&E objected and restricted project support. By October 1962 the Air Force had recognized that the work was out of balance--that too much emphasis had been placed on negation and too little on inspection, even though the latter was the primary objective. Subsequently, Under Secretary McMillan directed a reorientation to emphasize sensor development. The Air Staff cancelled previously planned launches and hardware work and, in March 1963, approved a four-step Phase Zero pre-program definition phase. Its purpose was to study potential satellite inspection concepts and missions and define the associated technical base and problems before undertaking further system development. With DDR&E approval, the Air Staff issued a new system program directive in May and, in June, OSD released Phase Zero funds.[7]

(S Gp-4) By the spring of 1964 AFSC had completed Phase Zero studies (in-house and under contract) and on 18 April it reported the results to the Air Staff. Among other steps, AFSC recommended discontinuing Program 706 and transferring its 1965 funds to a follow-on satellite interceptor. It also recommended development of a terminal-homing probe to improve the existing antisatellite system, as well as additional exploratory and advanced development on spaceborne inspection sensors and related technology because ground-based inspection systems--easily spoofed--would soon become outmoded.[8]

(S Gp-4) The 706 studies identified two technically feasible near-term systems for development on an interim basis. AFSC said that both could be acquired at moderate cost and, while having a relatively low capability, would be available at an early date. If emphasis were placed on a system with nonnuclear kill and limited inspection capability, the terminal homing probe was probably the best approach.

Conversely, if increased inspection and nonnuclear kill capabilities were desired, the Agena-rendezvous, coorbital approach would be the better choice.*

([redacted]) AFSC also reported on studies of several advanced manned, unmanned, and universal module approaches. These suggested that an advanced system should have the capability to carry out inspection and negation missions, either manned or unmanned, and be able to inspect targets at any altitude and inclination. For maximum satellite identification, a full complement of sensors plus a negation subsystem was required for integration into an advanced system. Of the advanced concepts studied, AFSC said the Titan III transtage universal module was probably the most feasible design from the standpoints of lower cost, earlier availability, and overall system performance.

([redacted]) The AFSC report noted that the acquisition of an interim, minimum spaceborne photographic inspection capability would constitute a significant improvement over any existing system. The Phase Zero studies indicated that if additional sensors were added, such as ferret and infrared sensors on a coorbital system, the potential for satellite mission identification would be increased. They also established that only a radiation detection sensor could provide positive identification of nuclear weapons, since these could not be reliably identified by other means. Furthermore, such a sensor was thought to be the only one which could distinguish an operational weapon from other spacecraft.

([redacted]) After the AFSC report was reviewed on 22 April and 5 June by the Air Defense Panel, the Air Staff and AFSC agreed that the latter should propose a spaceborne inspector sensor advanced development program, to be carried in the budget under the former Program 706 line item and redesignated as "Space Inspection." On 11 June the Air Staff directed AFSC to submit an appropriate plan as early as possible.[9]

* Many of the concepts reviewed by the 706 studies were incorporated in the follow-on programs discussed below.

[redacted]

Follow-on Antisatellite Systems

(S [redacted]) During the 27 June 1963 meeting at which he had directed the Air Force to get Program 437 operational, Secretary McNamara had also asked Dr. Brown to recommend a follow-on antisatellite system for his consideration by 1 November 1963. A major objective was to obtain maximum cost effectiveness and flexibility for future types of missions. Nonnuclear kill was an objective to promote accuracy and flexibility, although a nuclear kill system would be included as a high assurance alternative. Dr. Brown gave ARPA primary responsibility for the study, but he asked the Army and the Air Force to participate, specifically to evaluate any ARPA proposal. The Air Force was also directed to examine the feasibility of using Thor training flights or other Thor launches from Johnston Island to develop advanced subsystems such as controllable upper stage, local command midcourse guidance, and homing on ground based terminal guidance.[10]

Program 893

(S [redacted]) In its studies of a follow-on antisatellite system, designated Program 893, AFSC considered all ICBM's as possible boosters. The Minuteman II, however, emerged as the most attractive for both a nuclear-armed system and a nonnuclear homing system. If such range safety considerations as booster fallout were ignored, Minuteman II could intercept low altitude satellites during any orbit. A dual-purpose Minuteman which could be used either as an ICBM or as an antisatellite missile was feasible and had certain advantages. AFSC prepared a plan for what was designated as Program 893, listing three alternative approaches including one calling for a reoriented Program 437.[11]

(S [redacted]) On 10 October 1963 the Air Staff Board--after considering the AFSC plan--recommended that it be sent to DDR&E along with the statement that

[redacted]

the Air Force wanted to initiate development of a relatively simple terminal vehicle which would utilize Johnston Island resources, and follow this with a more sophisticated terminal vehicle adaptable to Minuteman II for which it would undertake a pre-Phase I definition study. On the basis of this work, it could then make specific recommendations concerning further development.[12]

([redacted]) Assistant Secretary Flax submitted the Air Staff evaluations of the various options to DDR&E on 16 October. By early December, however, several factors coalesced to make it fairly certain that the follow-on program would essentially involve an extension of the Johnston Island effort. The uncertain state of sensor technology, an apparently diminishing threat, the existence of the interim 437 and Nike-Zeus* programs, and the high cost of any follow-on system all militated against the proposal. Consequently, on 9 December Dr. McMillan suggested to the Chief of Staff that the Air Force take the initiative and orient its efforts toward a "Phase III" of Program 437. As he noted, one of the proposed USAF alternatives incorporated just such an approach. These conclusions meant the end of projected Program 893 for all practical purposes.[13]

Program 437X

([redacted]) The alternative plan proposed by AFSC for the 437 system was to develop a photographic satellite inspection capability. McMillan felt that by exploiting the resources of the basic 437 program, this capability could be acquired at relatively low cost. On 9 December 1963 he requested the Chief of Staff to submit a development plan based on this concept. McMillan observed that, while the Program 437 antisatellite capability was important to have in hand, there was,

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* An Army operation based on Kwajalein Island.

[redacted]

in fact, a low probability of its being used. On the other hand, an inspector version filling a complementary role held promise of frequent use.[14]

([redacted]) The photographic inspection version became known as 473X. An AFSC plan, completed by 23 December, was forwarded to DDR&E for review by the end of the year. To peg the program at the lowest possible cost, McMillan suggested that both the development and operational phases share the basic 437 facilities and the vehicles as well. In this manner, in view of the unlikelihood of 437 ever being committed, it would be possible to superimpose the "X" version upon it without an appreciable increase in cost.[15]

([redacted]) The 437X program was briefed to DDR&E late in March 1964. It called for the basic 437 system but with a new payload vehicle--similar to the Mk 2 reentry vehicle--containing a 162-type camera and a recovery system. The vehicle, launched from Johnston Island, would have neither warhead nor heat shield and employ a Bell Telephone Laboratories inertial guidance system. The Spadats network would provide target acquisition data. Stored programming data within the vehicle would activate the photograph equipment and direct ejection of film, etc. Launches would be limited to daylight hours, and 5 to 7 images of the target would be obtained. The inspector and the target would have to be moving in the same direction for photography and the interception would be limited to altitudes between 70 and 420 miles. Exposed film would feed into a recovery package which would be released by parachute. The Hickam-based C-130's employed on Program 162* would undertake aerial recovery of the film.[16]

([redacted]) A USAF program change proposal, submitted to DDR&E on 15 April 1964, called for four demonstration launches, the first in February 1965, followed by an initial operational capability for June 1965. Necessary modifications to the

* See Chapter IX, p. 92-3.

[redacted]

Johnston Island launchers could be completed within four to six weeks, making them compatible with both the 437 and 437X systems. At year's end, the Air Force awaited DDR&E approval of the new approach.[17]

The 437Y Version

([redacted]) Another aspect of the follow-on antisatellite studies considered by the Air Force and ARPA was a system equipped with a terminal homing device which would allow the use of a nonnuclear warhead for vehicle destruction. Identified as Program 437Y, this concept was ultimately funded at $3 million in 1964 and $4.6 million in 1965.

([redacted]) A preliminary development plan prepared by AFSC on 11 May 1964 and submitted to DDR&E described a Phase I project definition and Phase II acquisition of a terminal guided interceptor vehicle. The plan outlined a 12-month Phase I and an approximate 30-month Phase II leading to demonstration of a representative non-orbital satellite intercept vehicle system. The goal would be to achieve a "small miss distance" to allow use of a nonnuclear warhead and other compatible payloads. For increased flexibility, the payload section could be designed to permit interchange of nonnuclear, nuclear, and photographic payloads. However, the nonnuclear package would be the primary payload, an essential decision in light of the nuclear test ban treaty prohibiting nuclear explosions in space.[18]

([redacted]) Like 437X, 437Y would make maximum use of the basic Johnston Island resources. While the Air Force planned to launch the terminal homing vehicle with the same basic Thor booster, it would also attempt to design the payload package to fit other boosters, particularly Minuteman II. The Air Force proposed eight test launchings and installation of some technical support and launch facilities at Johnston Island.

([redacted]) Phase I competitive studies would take place between October 1964 and October 1965 and cost approximately $3 million. Phase II development and

[redacted]

test of the selected terminal homing vehicle would begin in October 1965 and continue through completion of flight tests in August 1968. The Air Force estimated Phase II costs at $107 million. At year's end, having received informal DDR&E approval of the preliminary development plan, the Air Staff was preparing a PCP for Secretary Flax to submit to OSD.

[redacted]

VIII. DEFENSE COMMUNICATION SATELLITES

([redacted]) After several years of work on the Advent military communication satellite system, OSD in the spring of 1962 reoriented this floundering effort, assigned program responsibility to the Defense Communications Agency (DCA) and the acquisition task to the Air Force, and charged DDR&E with exercising overall supervision. In place of Advent, Secretary McNamara approved two defense-communication satellites--Program 814, a synchronous orbit system, and Program 369, a random orbit system. DDR&E subsequently directed the Air Force to initiate a Program 369 definition phase, while temporarily suspending Program 814 because of funding.[1]

(U) In May 1963 the Air Force awarded 60-day study contracts to two industrial teams: General Electric's Missile and Space Division and the Motorola Corporation, and the Philco Corporation (Western Development Laboratories) paired with Space Technology Laboratories (STL). In September the contractors submitted their results to the Air Force. After evaluating them, the Air Force in the fall of the year recommended to DDR&E that Philco-STL undertake the Phase II development. However, by this time a new factor had entered the picture--DOD's "Year of Quiet Negotiations" with the civilian Communications Satellite Corporation (ComSatCorp) on the use of its spacecraft. The net result was a significant delay to the military program.[2]

The Negotiations With ComSatCorp

(U) Although it had been understood as far back as 1958 that the Defense Department would develop a separate military satellite system, Secretary McNamara--motivated by economic considerations--thought that the Communications Satellite Corporation might be able to satisfy defense needs. Established by law in August

[redacted]

1962, ComSatCorp the following summer selected three major contractors to study multiple techniques for communication satellites and to provide information which would lead to design of the first operational commercial sys[redacted] On 11 October 1963, following preliminary discussions, McNamara formally queried the ComSatCorp president, Joseph V. Charyk (former Air Force Under Secretary), on the proposition. McNamara noted that, on the basis of the completed definition phase, DOD "is now ready to enter into contract with three suppliers for the development, construction, and establishment of the necessary subsystems unless the Satellite Corp. can provide acceptable service at substantially lesser cost."

(U) Dr. Charyk responded immediately that the corporation would be happy to cooperate. There followed a period of prolonged negotiations which, although many difficulties were overcome, finally disintegrated on the issue of international agreements being sought by the United States. A few days after the end of fiscal year 1964, Deputy Secretary Vance broke off the negotiations with Dr. Charyk, noting that the State Department now judged it impossible to negotiate changes in the proposed international agreements to make them compatible with DOD's requirements.

[redacted] The negotiations with ComSatCorp cost the Defense Department a full year in the development of a communication satellite system. During the period DDR&E permitted the Air Force to extend contracts of the two industrial teams to insure retention of key contractor personnel and maintain continuity. On 23 September 1963 they were extended for two weeks, and on 9 October another 30 days. On 8 November, informally advised by DDR&E of a further delay, Dr. Flax authorized another 14-day extension, and he and Secretary Zuckert urged an early decision. Flax noted the duplicating costs and recommended that additional extensions be limited to Philco-STL alone. OSD agreed directing that the

[redacted]

Philco-STL contract be extended for 60 days and the other contract terminated. On 18 November the Air Staff directed AFSC to take these actions and the latest Philco-STL contract began on 25 November. This contract was extended four more times before Secretary McNamara announced on 15 July 1964 that DOD would "proceed with full development of a separate system." By this time, DDR&E had incrementally released $21.95 million to the program, including $13 million for procurement of Atlas boosters.[3]

Technical Progress During 1964

(U) Although it was not authorized to go into Phase II development during fiscal year 1964, the Air Force and its contractors made some technical progress during the year.

Traveling Wave Tube

([redacted]) One of the technical challenges inherited from the old Advent project during fiscal year 1963 was to adapt for military use the recently developed traveling wave tube--a lightweight, more sophisticated amplifying component superior to the traditional triode tube. The military need was for a traveling wave tube operable in the 7,000-8,000 megacycle range. At the time Advent was dropped, the Army had under contract the firm of Watkins-Johnson to develop such a component.

([redacted]) After reassignment of satellite component development to the Air Force, DDR&E directed initiation of a backup development effort to insure acquiring the new amplifier unit. The second contract was awarded to the Eitel-McCullough Corporation in June 1963. During fiscal year 1964 these parallel development efforts met with sufficient success that production models of a lightweight traveling wave tube with the desired capability were expected to be available in the new fiscal year.[4]

Gravity Gradient Stabilization

([redacted]) The Air Force's original request for proposals from industry on the random orbit system did not specify any particular method of satellite stabilization. The commonly accepted method employed was spin stabilization which, however, possessed the weakness of partially dissipating the satellite's communication capacity. An improved method, proposed but not yet proved, called for use of a gravity gradient system of stabilization to permit the antennae to remain always oriented toward the earth.[5]

([redacted]) By mid-1963 the Applied Physics Laboratory of Johns Hopkins University had been sufficiently successful in demonstrating the technique that DOD could no longer afford to ignore its possible application to Program 369, even though it still had to be demonstrated at the desired altitudes, between 5,000 and 6,000 miles. Late in July 1963 Dr. Brown directed the Air Force to have its [redacted] successful contractors modify their designs so the original spinning type could be converted without major change into a gravity gradient system. Insofar as possible, a capability was to be provided to substitute an experimental gravity model at such point that satellite production lines could be modified to effect in-line changeover to the new system without serious risk or delay.

([redacted]) On 15 August 1963 DDR&E generally approved an SSD-Aerospace plan for converting Program 369 to gravity gradient stabilization. Presuming a [redacted] first-flight date of 15 February 1964, one gravity gradient satellite could be included in the fourth launch, two on the fifth, and a full load on the tenth. Initially, the Air Force proposed to contract for 60 spin-stabilized satellites with provision to re-order either spin or gravity versions depending on the results of the fourth and fifth launches.[6]

([redacted]) By 12 October, however, additional experiments in the Navy's Project 435 had further demonstrated the feasibility of the gravity approach and Dr.

Brown decided DOD could now move more swiftly to use the newer technique. Toward this end, he directed the Air Force to organize a Program 369 study group that would consider specific application of the technique to communication satellites and recommend a preferred stabilization system.[7]

[redacted] Completed on 20 December 1963, the USAF study report clearly favored early application of the gravity gradient approach to stabilization. On 22 January the Air Force forwarded the report to DDR&E but, by that time, negotiations with ComSatCorp had reached a promising stage and DDR&E withheld any decision. Nevertheless, the gravity gradient approach to satellite stabilization had been accepted as feasible and was expected to be prominent in [redacted] future USAF development.[8]

Definition Phase Extension Work

(U) After the completion of the definition phase, the Philco-STL team continued to work in an extended definition phase pending the outcome of the DOD-ComSatCorp negotiations. Many tasks were accomplished which would ultimately ease the way if and when OSD gave the Phase II go-ahead. The contractor [redacted] performed PERT cost computations* and developed communication subsystem component specifications. It also conducted numerous studies in such areas as subassembly integration and single channel transponder, dispenser vibration, and satellite structure design; performed reliability analysis on the solar array and satellite dispenser components; and reviewed aerospace ground equipment (AGE) subsystem test requirements.[9]

The Air Force Qualitative Operational Requirement

[redacted] During the year, while the ComSatCorp negotiations were under way, the Air Force Communications Service (AFCS) completed a Qualitative Operational

* Program Evaluation Review Technique.

[redacted]

Requirement (QOR) for a USAF communication satellite system, which it published on 31 December 1963. In the document, AFCS stressed the shortcomings and limitations of both existing USAF communication systems and the proposed DOD satellite system. Of the existing five-element system--high frequency radio, tropospheric scatter, microwave, landline, and cable--AFCS observed that [redacted] virtually impossible to build enough redundancy into combinations of these five to assure a continuous reliable worldwide communication system. In the case of the 369 system, AFCS thought that it had limited growth potential, insufficient capacity, nonsurvivable ground environments, and high acquisition and operating costs.[10]

([redacted]) In support of its views, AFCS noted that the United States had been operating in Viet Nam for over two years but still did not enjoy reliable and continuous communications. Moreover, for the foreseeable future, the United States would continue to operate in areas of the world where communications were virtually non-existent. Although both the proposed DOD and ComSatCorp satellite systems would help, AFCS asserted neither would completely satisfy military requirements.

([redacted]) Criticizing the standard approach to increasing operating capability by providing "more channels, more radios, and more landlines," AFCS proposed "a quantum increase in communications capability" by adaptation of new techniques and procedures. Sepcifically, it proposed development of synchronous orbit satellites placed in specific locations with their movements controlled by simple air transportable, mobile ground stations. DOD would then be able to operate on a line-of-sight principle and communicate directly from the west coast to all bases in the Pacific without going through intervening ground relay stations. Survivability would be assured by random movement of the satellites. [redacted]

([redacted]) AFCS suggested that its ideal system could be reached in several stages. Initially, NASA,in cooperation with the Air Force, would place three syncom

[redacted]

satellites* in orbit by the end of 1966, using the Titan III booster. A year later, the number of satellites would be doubled at each location; by the end of 1968, a 10-satellite system would be established.

([redacted]) Second generation satellites with the capability of conducting satellite-to-satellite communication relay would follow by the end of 1969. During the 1970-74 period, there would be a twofold increase of satellites, all with relay and electronic countermeasure capabilities. During the same period, the feasibility of orbital command posts would be studied. Finally, during the 1973-78 period, satellite capability would be further enhanced and moon relay stations would be established.

([redacted]) The AFCS proposal received considerable Air Staff and field command support. On 10 March 1964, at a meeting at SSD headquarters, representatives of AFCS and the Air Force Systems Command, along with those of most other USAF commands, reviewed developments of the preceding 20 months--i.e., since the scrapping of Advent. The conferees generally endorsed the AFCS evaluation of existing and projected military communications and supported the proposed QOR for an Air Force communication satellite system.[11]

([redacted]) On the basis of this accord, AFCS recommended to Headquarters USAF that the Air Force establish an initial synchronous system using three Titan III test launchings to orbit the satellites. It noted that this initial capability could be augmented as required using additional Titan III vehicles until a follow-on system could be developed as projected in the QOR.

(U) It was obvious that even if ComSatCorp negotiations proved fruitful, there would be a substantial period before a commercial system could satisfy military

* NASA orbited its first Syncom satellite on 14 February 1963 but its communication gear failed. Syncom II, launched on 26 July 1963, successfully transmitted various messages.

needs. Consequently, DDR&E took a look at USAF's interim system proposal, and in May informally asked DCA and the Air Force to investigate its possibilities. On 29 June OSD formally directed the Air Force to obtain firm fixed price bids for such a system and intimated early project approval. [12]

IX. OTHER USAF SPACE PROJECTS

(U) During fiscal year 1964 the Air Force engaged in numerous other space-related activities. They included efforts to develop new reentry systems with aerodynamic characteristics, investigations of a standardized space guidance system, and continuing work to improve space detection and to advance solid propellant technology. These together with other significent activities are discussed in the following sections.

The ASSET/START Programs

[redacted] As noted earlier, when OSD decided to drop Dyna-Soar it compensated by expanding USAF's ASSET (aerothermodynamic/elastic structural systems environmental tests) project. It had been part of the Advanced Reentry and Precision Recovery Program initiated in June 1960 when McDonnell Aircraft Corporation received a study contract for a structural glide vehicle and a development contract 10 months later.

[redacted] By July 1963 the Air Force had separated the work into two elements--ASSET and precision recovery. ASSET had three objectives: (1) provide structural configuration concepts applicable to the design of aerospace vehicles operating in hypersonic flight environments; (2) establish analytical and experimental methods for predicting dynamic instabilities and reliability for lightweight structural designs of military aerospace vehicles; and (3) determine aerodynamic heating phenomena for military lifting reentry systems in low density flows. The objective of the other major element was to develop a capability for precision recovery of unmanned payloads from orbital vehicles and provide experimental data for assessing the feasibility of such recovery methods. However, work on the latter element was not immediately begun as McDonnell concentrated on the approved ASSET development.[1]

(U) By July 1963 McDonnell had produced the first ASSET vehicle--68.7 inches long and 58.9 inches wide, a 70° swept wing with 14 square feet of area, and a weight of 1,100 pounds. The upper surface was shaped like a conical cylinder, the bottom was flat. A test series of six flights was planned--four with aerothermodynamic structural vehicles (ASV's) and two with aerothermodynamic environmental vehicles (AEV's).[2]

(U) The four ASV's were to be boosted to reentry altitude and velocity--25,000 feet and 17,000-195,000 feet per second--by Thor or Thor-Delta boosters. The two AEV's were to use Thor boosters to attain a boostglide trajectory at an altitude of 170,000 feet and a speed of 13,000 feet per second. All would have a [redacted] recovery system consisting of a stabilizing parachute, main final descent parachute, and flotation devices. However, vehicle recovery was not essential since onboard instrumentation, about 100 sensors, would acquire and transmit data on temperature, pressure, and acceleration.

(U) On 18 September 1963 the Air Force launched ASV-1 down the Atlantic Missile Range. Although the vehicle was not recovered, telemetry and tracking [redacted] data revealed a successful test. The vehicle maintained aerodynamically stable flight. Data plots showed excellent correlation between actual and predicted flight paths as well as between free-flight and wind tunnel data. The reaction control system operated normally in pitch, roll, and yaw; and the velocity and altitude at the start of glide--16,106 feet per second and 20,00 feet--were within one percent of predicted figures.[3]

([redacted]) As noted above,* following this successful test, and coincident with Dyna-Soar's termination, Dr. Brown in December recommended an expansion in the work. AFSC subsequently prepared a development plan in which ASSET took its place as only one of five closely related but separately funded elements of a new program called START (spacecraft technology and advanced reentry tests).

* See pages

its objectives included many of those of the discontinued Dyna-Soar program as well as others required in establishing a technological base for lifting body reentry spacecraft. [4]

([redacted]) Using analytical studies, ground experiments, and flight tests, START was to explore problems of reentry conditions, materials, and techniques to obtain basic technical data and develop design characteristics. The five START elements were: ASSET, a subsonic/transonic flight test project, alternative configuration studies, advanced design studies, and the M-103 project. [5]

([redacted]) As distinguished from ASSET, which concentrated on radiative reentry vehicle structures, techniques, and materials, the M-103 project would investigate ablative heat shielding designs. The project's test vehicle, the SV-5, developed by the Martin-Marietta Corporation, was scheduled for four flights, beginning in December 1966. The vehicle would evaluate general handling characteristics, control system requirements, and piloting aspects of its configuration in the subsonic and transonic speed ranges and during landing approach and touchdown. These tests would be accomplished as part of a NASA evaluation program on the low speed characteristics of its own M-2 and HL-10 lifting body configurations.

([redacted]) The other two START elements consisted of alternative configuration investigations to assess the merits of competitive aerodynamic shapes for lifting reentry application, and advanced design studies to develop component and subsystem design concepts for improving the performance capability and mission adaptability of lifting reentry vehicles. [6]

(U) ASSET, meanwhile continued in accordance with its September 1963 schedule. The second vehicle was launched on 24 March 1964 from Cape Kennedy,

but the second stage of the Thor-Delta booster failed to ignite. A third test, on 22 July, however, was an outstanding success, including the first recovery of the payload. At the end of the fiscal year ASSET was on schedule and ground testing of AEV-1 was nearing completion, preparatory to its scheduled [redacted] October 1964.[7]

([redacted]) On 9 June OSD released deferred funds for the M-103 project. After being briefed on Air Staff plans, Dr. Flax on 30 June authorized obligation of the funds. SSD immediately began negotiations with Martin-Marietta for either extensions of the existing M-103 contract or execution of a new contract to cover the selected SV-5 configuration. Concurrently, SSD prepared work statements for the other three elements of the START program.[8]

Space Nuclear Power Arrangements

([redacted]) Current and planned military space systems required a long duration power supply for which nuclear reactors appeared to be the only feasible source. During 1962 and 1963 the Air Force had cooperated with the AEC, supporting that agency's Systems for Nuclear Auxiliary Power (Snap) projects. USAF plans (Snapshot) called for flight testing the reactors, Snap-2 and Snap-10A, which would generate 3 and 500 kilowatts, respectively. By early 1962 technical problems had forced AEC to postpone these tests until 1964 and 1965.[9]

Snap-2 and Snap-10A

([redacted]) During fiscal year 1964 the Snapshot programs almost came to a premature end. Snap-2 was cancelled, and the Air Force had actually issued a stop-work order on Snap-10A before the Congress intervened and brought about a resumption of work. This situation developed when OSD, reacting to certain congressional cuts in the 1964 budget, decided not to fund the nuclear reactor flight tests and suggested to AEC that it might desire to finance them if they were sufficiently important.[10]

[redacted] AEC wanted to proceed and, for that matter, so did the Air Force. In fact, the Air Force was willing to reprogram $9.3 million in 1964 funds to sustain the program at an appropriate level. This amount would allow completion of the ground test and provide a flight test option but with a slippage of up to 18 months due to booster procurement lead times. DDR&E concurred in this proposal, and encouraged the Air Force to attempt to get AEC to provide $2 million in 1964 in the hope of reducing the flight date slippage to one year. [11]

[redacted] Dr. Flax made this proposal to AEC on 29 July 1963. Subsequently, however, Dr. Hall, Deputy DDR&E for Space, reviewed the Snapshot arrangements and on 10 October recommended that AEC assume responsibility for management and funding of the entire effort. His recommendation was based on his conclusion that the flight testing of neither Snap-2 nor Snap-10A could be justified solely on military grounds. At his suggestion, OSD and AEC began to discuss the possibility of a transfer. [12]

[redacted] On 31 October Mr. A.R. Luedecke, AEC General Manager, stated that the agency felt so strongly about the importance of an early Snap-10A evaluation that it had explored means of reducing the flight delay. Having learned from Dr. Hall that DOD did not plan to fund the project beyond 1964, Luedecke suggested that in the interests of program continuity and efficiency, the $9.3 million in 1964 funds should be transferred to AEC along with program responsibility. The agency would then reprogram the balance needed in 1964 and put a line item in its 1965 budget to carry on. On 6 December Dr. Brown encouraged the Air Force to take the initiative in working out details of the transfer of responsibility to AEC. [13]

[redacted] Ten days later, however, OSD and the Air Force learned that the Bureau of the Budget (BOB) had eliminated the flight test of Snap-10A from AEC's budget. Moreover, it enjoined AEC from reprogramming from other sources. In

[redacted]

view of this action and the earlier DDR&E decision to transfer flight test funding responsibility to AEC, the Air Force prepared to terminate its 1964 effort in the Snapshot program upon formal notification from AEC. On 21 December AEC dropped all plans for Snap-2, and six days later the Air Force issued a stop-work order to its contractor on Snap-10A. On 29 January, however, Dr. Glenn T. Seaborg, Chairman AEC, assured Secretary Zuckert that he could obtain a reversal of the BOB decision. To provide Seaborg some time, the Secretary requested the Vice Chief of Staff to delay termination action for 10 days.[14]

(U) At this point, the Congress intervened, its Joint Committee on Atomic Energy criticizing both DOD and AEC for vacillating policies. The committee chairman, Representative Chet Holifield, advised the Bureau of the Budget on 15 February that the committee intended to authorize AEC to flight test Snap-10A and would move to obtain the necessary appropriation. Pointing out that the device could be ready for flight in the spring of 1965, the congressman noted that the estimated cost would be only $12.4 million over funds already furnished [redacted] Holifield recommended that AEC be permitted to transfer this amount from other projects to stay within its 1965 budget.[15]

(U) Holifield and Senator John O. Pastore also informed Secretary Zuckert that it was their opinion, following two days of hearings on the subject, that flight testing of Snap-10A was in the national interest. They advised Zuckert of their intention to include authorization for such tests in the AEC budget so the Air Force could be prepared to take the step without further loss of time and money.[16] On 26 March the committee voted to provide $14 million in AEC's 1965 budget for the project. Following this action, Holifield and Pastore again expressed to Zuckert their interest in having the Air Force and AEC meet the 1965 launch date.[17]

(U) In the face of such Congressional pressure, AEC and the Air Force were quick to work out the appropriate arrangements. They set a funding level for the

(This page is [redacted])

[redacted]

remainder of 1964 at $4.9 million, of which the Air Force provided $2.2 million, while the 1965 funds of $14.6 million would be furnished by AEC. The Air Force contractor resumed work on 20 April 1964, aiming toward a flight date of 1 April 1965.[18]

(U) In the meantime, consultations continued on transferring responsibility to AEC. On 19 May Luedecke proposed an agreement which Secretary Zuckert modified slightly on 9 June in consonance with the advice of the Air Force General Counsel. Dr. Seaborg accepted the change on 22 June and, at year's end, AEC had management responsibility for Snap-10A, and the Air Force retained launch responsibility.[19]

Snap-50/Spur

(S-Gp-4) Snap-50/Spur was a cooperative USAF-AEC-NASA project to develop the technology for lightweight nuclear space power equipment rated at 300 to 1,000 [redacted] KW and designed for 10,000 hours of continuous operation. During fiscal year 1964 both AEC and DOD cut back on their work, OSD limiting the Air Force to $1 million for an investigation of design constraints imposed on the power unit by the flight test vehicle.[20]

Space Detection and Tracking

(S-Gp-4) During the early months of fiscal year 1964 the Air Force submitted two program change proposals to DDR&E to cover proposed improvements to [redacted] Spadats' reaction time and prediction accuracies. The first, submitted on 22 July 1963, requested permission to complete and place on 24-hour duty the single face of the phased array radar at Eglin AFB, Fla. It also requested funds to develop a parallel network computer and interferometer radar and to acquire equipment and spares to place both the Eglin and Cloudcroft sensors into an operational configuration. The second proposal, submitted on 2 October, was specifically oriented toward improved support of Program 437, by installing a new radar in Hawaii,

improving communications between the Spadats radars and the computer center, and augmenting data processing capabilities for various radars including the ballistic missile early warning system (BMEWS) sites and the duplex automated computer facility at the Spadats center.[21]

(S-Gp-4) In response to the first PCP, OSD on 5 October agreed to fund spares for the phased array radar and approved $3 million (of the $17 million requested by the Air Force) for the interferometer. This would not permit full-scale development of an operational interferometer but would suffice to advance technology to the point of a feasibility demonstration of the interferometer technique. Development of the parallel network computer and expansion of the radar capability were disapproved.[22]

(S-Gp-4) On 30 November 1963 OSD disapproved the second USAF proposal (of 2 October), stating that the Air Force had not fully justified the Hawaiian radar and that the other items were included in other approved projects. It was true that one item, satellite processing for the BMEWS sites, was already in the 1965 Spacetrack* program. Otherwise, the Air Force believed the requested improvements were new, unfunded items; nevertheless, OSD also rejected an Air Staff reclama made in December.[23]

(S-Gp-4) The fiscal year 1963-64 series of OSD approval-disapproval actions once again left the Air Force in the position of trying to fill an operational need with development equipment. Approval of the single faced phased array radar at Eglin AFB, a prototype optical surveillance system at Cloudcroft, N. M., and the interferometer development did not permit the Air Force to implement an operational system to meet the JCS-approved Spadats requirements. Nor did it permit the degree of operational support of Program 437 apparently desired by the Secretary of Defense. As a matter of policy, the Air Force insisted that if it were to meet the requirements of the North American Air Defense Command (NORAD) and

* Spacetrack was the USAF component of the space detection and tracking system.

acquire a meaningful antisatellite system, it should be permitted to go beyond the existing Spadats development.[24]

([redacted]) Despite USAF misgivings, reviews of the system's status during and shortly after fiscal year 1964 disclosed that considerable progress had been achieved and a definite capability acquired. With respect to Program 437 support, Spacetrack predictions had been well within its requirements and contributed to the series of successful Johnston Island launchings that led to the initial operational capability. Moreover, with each successive exercise of the system, Spadats performance improved as personnel became familiar with 437 needs and operation of the individual Spacetrack sensors was refined.[25]

([redacted]) In addition to the above activity, on 8 May 1964 ADC accepted the AN/FPS-79 tracker radar at Diyarbakir, Turkey. This facility operated in the ultra high frequency bandwidth and was capable of detecting targets of one square meter at ranges out to 2,500 miles. It could also perform quick look signature analysis on all targets passing through its tracking beams. The location of Diyarbakir facilitated detection of all Soviet space launchings from the Tyuratam range within minutes of takeoff and again during the latter portion of the satellite's first orbit.[26]

([redacted]) Meanwhile, work proceeded on the Shemya modification, scheduled for completion in November 1964. Like the Diyarbakir facility, this AN/FPS-80 radar possessed on-site processing equipment and a quick look signature analysis capability. The prototype optical sensor at Cloudcroft, originally scheduled for completion in October 1964, would not be available until March 1965, the slippage due to equipment modifications. The facility at Eglin AFB was scheduled for complete acceptance testing in April 1965.

[redacted]

Standardized Space Guidance System

([redacted]) The Titan III development plan approved by OSD in the summer of [redacted] had called for use in the early years of a modified Titan II guidance system. Looking ahead to a follow-on system, DDR&E in September of that year outlined to the Air Force a concept for a device that might be useful. In May 1963 the Air Force submitted to OSD a standardized space guidance system technical development plan which incorporated the DDR&E ideas.[27]

([redacted]) On 6 August Deputy Secretary Gilpatric approved the proposed program element (6.44.09.18.4), "Standardized Space Guidance," which incorporated the old element (6.34.12.03.4), "Stellar Inertial Guidance," on whose technology [redacted] build. The first phase of the system development involved a series of analytical mission investigations conducted by several contractors into the spectrum of advanced space guidance missions: (1) maneuverable orbital spacecraft, including precision altitude control, space navigation, and engine control for spacecraft "jinking;" (2) precision recovery of maneuverable orbital spacecraft; (3) precision station keeping in orbit (inspection); (4) rendezvous guidance concepts (destruction and non-destruction rendezvous); and (5) injection of multiple payloads into different orbits.[28]

([redacted]) The analytical mission studies were to lead eventually to guidance system specifications. The study phase was funded by $3 million during fiscal year 1964. After considerable review and some revision of the AFSC work statement by the Air Staff, OSAF, and DDR&E, requests for proposals were sent to industry on 13 September. On 26 November the AFSC source selection board findings were accepted by Dr. Brown, and four contractors began parallel studies on 29 January 1964.[29] Preliminary evaluation of the completed studies at the end of the fiscal year indicated that feasibility had been established. A go-ahead was expected in August after AFSC presented its findings and a recommended development plan to OSD.[30]

[redacted]

Nuclear Detection Satellites

([redacted]) By fiscal year 1964, the ARPA-AEC-USAF nuclear detection satellite project, identified as Program 823, had reached its second phase--orbital testing--with its importance considerably enhanced by the nuclear [redacted] treaty. Five launchings with Atlas-Agena boosters were programmed from Cape Canaveral during the year. ARPA intended to orbit as many spacecraft as necessary to determine the normal radiation environment in space and to define the sensing parameters for the satellite detectors. Once this was accomplished, pre-prototype detectors were to be built and launched.[31]

([redacted]) By October preparations were complete for the first orbital test flight of a pair of identical spacecraft. The flight plan called for placing them into an approximately circular orbit 50,000 miles above the earth and 140° apart, where they would operate for a minimum of six months in detecting X-ray, gamma ray, and neutron signals similar to those resulting from nuclear detonations.[32]

([redacted]) The launch of Program 823 Flight Test Vehicle No. 1 on [redacted]ber was perfect. All phases of early operation--launch, initial trajectory, and transfer orbit--were as programmed. The first satellite was injected into the desired orbital path on 17 October, 17 hours and 23 minutes after launch; 38 hours later, on 19 October, the same was done with the second spacecraft. All programmed events after injection, including start and checkout of AEC payload equipment, proceeded normally.[33]

(U) At the end of January 1964 OSD announced that the performance of the satellites continued to be excellent in all respects and that they had "moved the research program forward by more than one year." Several months later, on 27 April, ARPA announced that the "complete success" of the early test had led it to expand and revise the project. On 30 June the satellites were still transmitting highly useful data, and AFSC estimated that the early success of the project (now redesignated Program

638) had saved DOD $33 million. At year's end, while preparations moved ahead for a second launch, AFSC sought to define the characteristics of an operational system.[34]

Large Solid Propellant Motors

(S Gp-4) By the spring of 1963 DOD and NASA had agreed to proceed with large solid propellant motor (Program 623A) feasibility demonstrations. The ultimate aim was to develop a product which might be used with the space agency's Nova booster. The Air Force subsequently requested proposals from industry on four separate packages: (1) demonstration firings of half-length 260-inch motors; (2) demonstrations of a fixed 3,000,000-pound thrust nozzle on a 156-inch motor; (3) demonstration of a moveable 1,000,000-pound thrust vector control system mounted on a 156-inch motor; and (4) demonstration of a jet tab thrust vector control with a 1,000,000-pound thrust nozzle mounted on a 156-inch motor. Two contractors, Thiokol and Aerojet-General, were successful bidders on the first package, Thiokol alone won the contracts for the second and third packages, and Lockheed was selected for the fourth task.

(S) Just as contract negotiations were completed, however, a congressional slash of $2 billion from the 1964 appropriations bill prompted OSD in mid-June to withhold all funds from Program 623A (among other projects). An Air Force reclama succeeded in having $16 million restored.[35] However, in reinstating the funds on 3 July, OSD restricted work to the 156-inch motor development, advanced technology, and related components. OSD stated that it could no longer justify development of a 260-inch solid first stage for Nova prior to fiscal year 1965 in light of certain NASA program changes. However, although deferring 260-inch development in 1964, OSD added that the decision was tentative pending interagency review.[36]

(S) When informed of OSD's tentative decision to reduce the 260-inch motor effort. Mr. Webb on 5 August expressed his concern to McNamara and restated his desire that feasibility be demonstrated at an early date. Webb also conveyed these views to Sen. Richard B. Russell, member of the Senate committees on aeronautical

and space sciences and on appropriations and mustered some congressional support.

(S Gp-4) A study, undertaken by DDR&E and the Air Force, concluded on 18 August that DOD could conduct an effective program for both the 156- and 260-inch motors for $34 million. In general, it proposed a stretched out 260-inch effort which would permit deferral of $12 million to 1965. This had the advantage of meeting DOD's obligation to support NASA by conducting the experiments leading to determination of the feasibility of the 260-inch motors. At the same time, the date for decisions on initiating an effort leading to a full-length firing would be postponed for a year. By that time, DOD officials thought, NASA would have firmer plans for the Nova vehicle.[37]

(U) On 20 August Gilpatric told a Senate appropriations subcommittee that, in view of the importance NASA attached to the work and DOD's commitment to advance solid fuel technology, even if the military had no immediate or even long-range requirement for it, OSD had decided to continue development. However, he failed to persuade the Senate to restore $18 million specifically for this purpose, and the appropriations bill included the recommendation that no more than 10 percent be cut from the original $34.3 million requested in the budget. This would put the 1964 program at $30.87 million.[38]

(S Gp-4) On 19 November Deputy Secretary Gilpatric advised the Air Force to proceed at this funding level, and AFSC subsequently took steps to carry forward the contractual effort.[39] Meanwhile, Dr. Brown informed Dr. Seamans of these actions but again indicated DOD's general disinterest in the 260-inch phase for NASA. He urged NASA to set aside funds in 1965 and in later years to help complete the development.[40] After discussing the possibility with the Bureau of the Budget, Seamans advised Brown that he would defer a decision until after the Congress had acted on the 1965 NASA budget, at which time he would resume discussions with Brown about future management of the 260-inch work.[41]

[redacted]

([redacted]) On 13 January 1964 the Air Staff issued a system program directive for Program 623A, and on 12 March AFSC forwarded a new system program package to Headquarters USAF. The document, which incorporated all management decisions taken since the project began, amounted to a status report of the initial two-year program approved by Dr. Brown in March 1963. The Air Staff Board quickly approved the package, and Dr. Flax forwarded it to DDR&E on 23 March.[42]

(U) With the decision to go ahead, funding provided, and no technical problems having interposed themselves, Program 623A was in excellent shape by the end of fiscal year 1964. In May, Lockheed had fired the first 156-inch motor at Potrero, Calif. The motor developed 900,000 pounds of thrust and its components--jet tabs, a high nickel steel case, and an ablative throat nozzle--successfully held up under the pressure. The motor case used in this test was refurbished for a second firing during the next fiscal year. Test firings of 260-inch motors also were planned.[43]

Meteorological Satellites

([redacted]) According to national policy, NASA had responsibility for developing meteorological satellites to satisfy the requirements of all agencies. The original program called for Tiros (Television Infrared Observation Satellites) to be followed by the more sophisticated Nimbus system which was expected to become operational in 1963. The first Tiros satellite was launched in April 1960, and by fiscal year 1964 three others had orbited. Meanwhile, Nimbus had fallen about three years behind schedule.[44]

([redacted]) In January 1963, in the wake of the Cuban crisis, the Air Force, the Navy, OSD, and JCS reviewed the national meteorological program. As a result, on 5 March the Joint Chiefs recommended that the existing program be supplemented to provide direct readout satellites to meet immediate military requirements.[45]

([redacted]) In general, the Air Force needed a capability which would furnish local weather satellite pictures as soon as possible in addition to the stored pictures. This

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capability would be invaluable in support of such localized military operations as the Cuban crisis. According to the USAF evaluation in the spring of 1963, neither Tiros nor Nimbus could completely satisfy this requirement. Tiros, launched from Cape Canaveral, could not view the earth at a longitude higher than 60°, which omitted vast areas of military interest. Moreover, due to the fixed orientation of its camera system, Tiros could obtain useful pictures of the earth only about 20 percent of the time. Whatever operationally useful data that Tiros obtained were usually delayed about six hours for processing. The immediate problem with Nimbus was that it would not be operational until 1965. Even then, it would not meet military requirements.[46]

([redacted]) Concurrent with the DOD review and faced with the Nimbus slippage, NASA and the Weather Bureau began work on a Tiros operational satellite system (TOSS) to provide an interim national capability. The plan called for orbiting a total of nine development and operational satellites, the first late in 1963. The next two would have an automatic picture transmission sub-system (APTS) and be earth-stabilized, a decided advantage over the basic Tiros. APTS would transmit a picture on a real time readout basis (208 seconds). A ground station could receive up to three pictures on each satellite pass. DOD proceeded to purchase equipment for 27 such stations, and the Air Force scheduled 20 stations to become operational by late 1963.[47]

([redacted]) OSD anticipated that NASA and the Weather Bureau would reach agreement on some kind of substantial program by the late summer of 1963. When the two agencies failed to do so, the JCS reopened the subject, urging DDR&E to authorize a military system immediately.[48] Meanwhile, the Weather Bureau concluded that Nimbus as then conceived would be too expensive for the results achieved. Consequently, in September 1963 the Commerce Department withdrew from the Nimbus arrangements and initiated discussions with NASA about expanding TOSS. In light of

[redacted]

these developments, Dr. Fubini on 13 January 1964 directed formation of a DOD working group to re-survey defense needs.[49]

(U) The group concluded that an interim TOSS system would partially fulfill DOD requirements. Subsequently, DOD representatives discussed the matter with the Commerce Department which by late March noted its support of the TOSS system. NASA, meanwhile, prepared a development plan to satisfy these joint requirements by late 1965.[50]

(U) The plan called for employing pairs of Tiros satellites in a "wheel" configuration. Placed into a 450-mile altitude orbit and oriented to the sun, the system would cover about 95 percent of the sun-illuminated portion of the earth each day. Initially, it would not be possible to provide nighttime cloud pictures or direct local readout. However, plans were in being to provide this growth shortly.

(U) After reviewing the NASA proposal, Dr. Fubini on 1 April 1964 agreed that the general technical characteristics of the proposed system would meet minimum defense requirements. But he stipulated that, in addition to incorporating infrared sensors in TOSS as soon as possible, 300 cubic inches of space and a weight allowance of 10 pounds were required on the spacecraft for a DOD device to provide a measure of command and control security for use duirng periods of tension--the existence of the device to be kept secret.[51]

(U) On 23 April Dr. Fubini extended the charter of the DOD working group and assigned it the additional tasks of monitoring progress of the national system and coordinating DOD requirements with NASA and the Weather Bureau.[52]

Program 162 Discontinued

(U) In April 1964 one of the nation's oldest space efforts came to an end as the Air Force discontinued Program 162, previously known as Discoverer. It had

emerged in 1958 from USAF's original satellite undertaking, WS-117L. In February 1964 Secretary McMillan, General LeMay, and General Schriever agreed that the program had reached the point of diminishing returns, i.e., the results no longer warranted the expenditure of resources. Consequently, they arranged for its termination.[53]

(U) In addition to being one of the oldest, Program 162 was one of the most successful, and its 78 launches between 28 February 1959 and 27 April 1964 accounted for many of the breakthroughs in U.S. and Air Force space technology and techniques. A Discoverer capsule was the first space object to be recovered from orbit (an ocean recovery). Another capsule was the first to be returned from space and caught in mid-air, in the prototype of a C-119 recovery operation which soon became routine. In addition to increasing knowledge of the space environment, Program 162 assisted greatly in advancing technology and development of the DM-21 Thor, the improved Thor, the Agena space vehicle, and the Worldwide Satellite Control Network.[54]

The Project 435 Booster

([redacted]) During early fiscal year 1964 there was considerable concern over the reliability of NASA's Scout rocket, a multi-stage vehicle which could be assembled in various configurations depending upon payload and mission. One of Scout's assigned payloads was the Navy's navigation satellite (Project 435), for which the Air Force procured boosters from NASA. The Navy project had been scheduled to complete its development phase during the fiscal year and become operational in the summer of 1964. As NASA initiated a review of the Scout reliability, DDR&E in December 1963 approved a Navy request to procure three Thor-Able-Star vehicles to protect the operational schedule. Brown reminded the Air Force of its responsibility to support the Navy and requested that the two services jointly decide on the appropriate booster for 435.[55]

[redacted]

(U) 1) On 15 January 1964 Dr. Flax met with representatives of the Navy and the Air Staff to review the NASA reliability improvement plan. They concluded that, if implemented, it would in time enhance Scout reliability to about 65 percent. However, the Air Force believed that a much higher reliability--around 80 percent--was possible and urged NASA to bring this about by undertaking a complete design review of the Scout vehicle as well as a flight qualification program.[56]

(U) In the meantime, the Air Force had on hand eight Scout vehicles and took preliminary steps to procure the three Thor-Able-Star vehicles requested by the Navy. The final procurement decision was put off until September 1964, by which time five more Scout rockets would have been launched, providing additional data on which to judge the merits of Scout for Project 435. In the longer view, the Air Force planned to launch, later in 1964, a Scout vehicle incorporating a new fourth stage specifically designed to perform the 435 mission. However, against the possibility of unforeseen difficulty or continued Scout unreliability, Dr. Flax agreed that it was prudent for the Navy to program enough 1965 funds to procure additional Thor-Able-Star vehicles. Dr. Brown agreed with these views but cautioned the Air Force not to proceed with contracts for the new fourth stage pending a complete review of 435 by the Navy.[57]

[redacted]

NOTES

Chapter I

1. Carl Berger, The Air Force in Space Fiscal Year 1962 (S), (AFCHO, 1966), pp 18-20; Gerald T. Cantwell, The Air Force in Space Fiscal Year 1963 (S), (AFCHO, 1966), pp 3-8 (hereinafter referred to as Cantwell).

2. Ltr (U), M/Gen J.W. Carpenter III, D/Plans to M/Gen A.J. Kinney, D/Dev, 31 Oct 63, subj: USAF Space Objectives; Ltr (U), L/Gen W.H. Blanchard, DCS/R&D, 3 Feb 64, subj: USAF Space Objectives, both in D/Plans RL (64) 67-1.

3. Hist (U), D/Plans, Jan-Jun 64, pp 248-50; Ltr (U), Gen C.E. LeMay, CSAF to Air Force (transmitting USAF Space Objectives), 20 Apr 64, subj: USAF Space Objectives, in D/Plans RL (64) 67-1.

4. USAF Space Objectives (S), Apr 64, in D/Plans RL (64) 67-1; Hist (S), D/Plans, Jul-Dec 63, pp 305-7.

5. Intvw (U), author with Col Frank G. Richie, Ch, Policy & Plans Grp; D/Space, 7 Mar 67.

6. Rprt (U), of Space Panel of Project Forecast Support Panel, Mar 64.

7. Ibid.

8. Ibid.

9. Interim Rprt (U), Preparedness Investigating Subcmte, 88th Cong., 1st Sess., Military Implications of the Proposed Nuclear Test Ban Treaty; Rprt (U), Cmte on Foreign Relations, 88th Cong., 1st Sess., The Nuclear Test Ban Treaty; Hearings (U), Preparedness Investigating Cmte, 88th Cong., 1st Sess., Military Aspects and Implications of Nuclear Test Ban Proposals and Related Matters; Hearings (U), Cmte on Foreign Relations, 88th Cong., 1st Sess., Nuclear Test Ban Treaty.

10. Address (U), John F. Kennedy before General Assembly of United Nations, 20 Sep 63, in Public Papers of the Presidents, John F. Kennedy, 1963, No 366, pp 693-8; National Security Action Memo No 271 (C), s/John F. Kennedy, to Administrator NASA, 12 Nov 63, subj: Cooperation with U.S.S.R. on Outer Space Matters, in D/Plans RL (63) 67-1.

11. Memo (U), R/Adm J.W. Davis, Dep Dir JCS Joint Staff, to SOD, 28 Jan 64, subj: U.S. - U.S.S.R. Cooperation in Space Research Programs; Rprt (S), USAF Study Pertaining to the National Lunar Program, Apr 64, Vol I; Memo (S), CSAF to JCS, 21 Apr 64, subj: Study Pertaining to National Lunar Program, both in D/Plans RL (63) 67-1; Memo (TS), LeMay to SOD, 4 Jan 64, subj: U.S. - U.S.R.R. Cooperation in Space Research Programs, in D/Plans RL (64) 67-1.

12. Memo(S), M/Gen R.F. Worden, D/Plans to CSAF, o/a 31 Jan 64, subj: Study Pertaining to the National Lunar Program, as Tab C in Background Paper, same subj: Memo (S), B/Gen M.J. Ingelido, Secy JCS, for CSAF et al, 31 Dec 63, subj: Study Pertaining to National Lunar Program; Memo (C), J.W. Davis to SOD, 10 Feb 64, subj: Clearance of Draft Position Papers on Outer Space; Memo (S), Peter Solbert, Dep Asst SOD (ISA), to M/Gen A.J. Goodpaster, Spec Asst to Chmn JCS, 23 Dec 63, subj: Declaration of Legal Principles Regarding Outer Space; Memo (C), Solbert to JCS, 6 Feb 64, subj: Clearance of Draft Position Papers on Outer Space; Rprt (C), Joint Staff to JCS, 10 Feb 64, subj: Clearance of Draft Position Papers on Outer Space, all in D/Plans RL (64) 67-1; Rprt (C), Joint Staff to JCS, 28 Jan 64, subj: U.S. - U.S.S.R. Cooperation in Space Research Programs, in D/Plans RL (63) 67-1; Resolution adopted by United Nations General Assembly, 13 Dec 63, "Declaration of Legal Principles Governing the Activities of States in the Exploration and Use of Outer Space."

13. DOD Dir 5030.18, 24 Feb 62.

14. Ltr (U), M/Gen J.K. Hester, Asst V/CSAF, to AFSC et al, 24 Dec 63, subj: Support Relationships with NASA.

15. Astronautics and Aeronautics Events, 1964, p 64 (hereinafter referred to as A&A Events, 1964).

16. Hist (U), D/Dev, Jul-Dec 63, pp 18-19; rept, Cmte on Government Operations, Government Operations in Space, p 98, 89th Cong, 1st Sess.

17. Hist (U), D/Dev, Jan-Jun 64, p 19; intvw, author with Maj Donald Koretz, Support Division, D/Space, 19 May 67.

18. Agreement (U), USAF-NASA Memorandum of Agreement, 9 Aug 63, subj: Agena Launch Veh Program; Memo (U), Brockway McMillan, U/SAF, to SOD, 19 Aug 63, subj: Agena D Management, in OSAF 50-63, vol 1.

19. Ltr (U), R.L. Gilpatric, Dep SOD, to J.E. Webb, Administrator NASA, 22 Aug 63; Ltr (U), Webb to Gilpatric, 27 Sep 63, both in OSAF 81-63; Memo (C), A.C. Hall, Dep DDR&E (Space), to ASAF (R&D), 19 Feb 64, subj: Launch Veh Proliferation, in OSAF 23-64, vol 1.

20. Memo(S), C.R. Vance, Dep SOD, to SAF et al, 3 Apr 64, subj: National Launch Veh Program; Memo (U), A.H. Flax, ASAF (R&D), to E.M. Zuckert, SAF, 5 May 64, both in OSAF 23-64, vol 1.

21. Hist (U), D/Develop Plans, Jan-Jun 64, pp 53-4; Hist (U), D/Develop, Jan-Jun 64, pp 68-9.

22. Ltr (U), R.C. Seamans, Assoc Administrator NASA, to Harold Brown, Dir DDR&E, 6 Mar 64; Ltr (U), Seamans to Brown, 10 Jun 64, both in OSAF 23-64, vol 1.

23. Memo (U), J.C. Jones, Dep/Dev, ASAF (R&D), to D/Dev, 12 Jun 64, subj: DOD-NASA Agreement on Delta Capability at PMR; Memo (U), Flax to DDR&E, 18 Jun 64, subj: DOD-NASA Agreement on Delta Capability at PMR, both in OSAF 23-64, vol 1.

24. DOD Release No 1494-63, 20 Nov 63, subj: Mgt of Msl and Space Test Range Facilities Reassigned; Hist (U), ISTRATAD, Jan-Jun 64, pp 111-29; Hist (C), D/Dev, Jul-Dec 63, pp 19-23; Hist (U), D/Dev, Jan-Jun 64, pp 15-16.

25. Memo ([redacted]) McNamara to SAF, 25 Apr 64, Mgt and Organixation of DOD Ranges and Flight Test Facilities; Memo (S-Gp 4), McMillan to Fergusan, 5 Jun 64, proposed PCP for the Satellite Tracking and Central Facilities both in AFRDSE R&D 5-7.

Chapter II

1. Cantwell, pp 15-31.

2. Ibid., pp 26-27.

3. Rprt (U), D.B. Holmes & B. McMillan, Co-chmn Manned Space Flt Panel, to AACB, 27 Jun 63; Memo (U), co-chmn Manned Space Flt Panel to AACB, 2 Aug 63, both in Space Div R&D 9.

4. Ltr (U), Lyndon B. Johnson to R.S. McNamara, SOD, 22 Jul 63, in Space Div R&D 9.

5. Ltr ([redacted]), McNamara to Vice President, 9 Aug 63, in Space Div R&D 9.

6. Ltr (U), McNamara to Webb, 8 Aug 63, in Space Div R&D 9.

7. Ltr (U), Webb to McNamara, 17 Aug 63, in Space Div R&D 9; Ltr (U), McNamara to Webb, 16 Sep 63, in OSAF 1763-63.

8. Agreement (U), DOD and NASA, subj: Possible New Manned Earth Orbital Research and Dev Project, s/Webb, 17 Aug 63, McNamara, 16 Sep 63, in OSAF 1764-63; DOD Release No 138--63, 17 Oct 63, subj: NASA-DOD Agree on Common Approach to a Manned Orbital Research and Dev Project.

9. Memo([redacted]), Brown to SOD, 14 Nov 63, subj: Approaches to a Manned Mil Space Program.

10. Ibid.

11. Memo ([redacted]), Brown to SOD, 30 Nov 63, subj: Evaluation of an Orbital Mil Test Module.

12. Ibid.

13. Memo ([redacted]), Gilpatric to SAF, 5 Dec 63, subj: Changes in DOD Space Programs, in OSAF 5-63; Memo (S), Flax to Zuckert, o/a 30 Nov 63, in OSAF 50-63, vol 4; McNamara News Briefing at Pentagon, 10 Dec 63; Memo (U), McNamara to SAF, 11 Dec 63, subj: Changes in DOD Space Programs.

14. Chief of Staff Policy Book ([redacted]), 1964, Item 11-21, 1 Jan 64, subj: X-20A (Dyna-Soar) Program.

15. Editorial, J.S. Butz, Jr., "MOL--A Plus With Some Minuses," in Air Force and Space Digest magazine, Jan 64.

16. Ltr (S), L/Gen J. Ferguson, DCS/R&D, to Gen W.F. McKee, V/CSAF, 7 Aug 63, subj: National Space Station Program, in Space Div R&D 9.

17. Ltr (U), Hester to Ferguson, 15 August 63, subj: Manpower--Space Station Program, in Space Div R&D 9; Ltr (U), McKee to Deps, Dirs, and Chiefs of Comparable Offices (No 65), 23 Sep 63, subj: The Air Force and the National Space Station Program, in OSAF 1764-63.

18. Memo (U), McMillan to V/CSAF, 27 Sep 63, subj: The Air Force and the National Space Program, Memo (U), McMillan to DDR&E, 27 Sep 63, subj: The Air Force and the National Space Program, both in OSAF 1764-63.

19. DAF SO GA-53, 8 Jun 64; Ltr (U), McMillan to Gen B.A. Schriever, Comdr AFSC, 6 Feb 64; Memo (U), McMillan to CSAF, 29 Apr 64, subj: MOL Coordination Office; Ltr (U), Hester to Deps, Dirs, and Chiefs of Comparable Offices (No 28), 9 Jun 64, subj: MOL Coordination Office, all in OSAF 1764-63.

20. Ibid.

Chapter III

1. Cantwell, pp 18-24.

2. Memo (U), Flax to DDR&E, 22 Nov 63, subj: X-20A (Dyna-Soar) Sys Package Program; Ltr (S), L/Gen H.M. Estes, AFSC Vice Comdr, to Ferguson, 17 Oct 63, subj: X-20A Sys Package Program; Memo (U), Flax to DDR&E, 9 Aug 63, subj: X-20A (Dyna-Soar) Booster Ground Rules; Memo (U), Brown to ASAF (R&D), 15 Aug 63, subj: X-20A (Dyna-Soar) Ground Rules; Memo (U), Flax to DDR&E, 28 Oct 63, subj: AMR/PMR X-20A Support Funds, all in OSAF 370-63; Rprt (C), Air Staff Board Mtg 63-47, 17 Oct 63; Ltr (U), Capt E.W. Deheart, Asst Exec Secy ASB, to members ASB, 14 Oct 63, subj: Notice of Air Staff Board Mtg, in D/Plans RL (63) 12, Sec 2; Memo (U), Hall to ASAF (R&D), 11 Sep 63, subj: Land Recovery of Space Vehicles, in Space Div R&D 3; Rprt (C), Space Panel Mtg 63-18, 11 Oct 63; Minutes (S), 74th DSM Mtg, 23 Oct 63; Hist (U), D/Dev, Jul-Dec 63, pp 72-87.

3. Hist (S), Aeronautics Sys Div, Jul-Dec 63, Vol IV, Termination of the X-20A Dyna-Soar.

4. Memo (S), Zuckert to SOD, 4 Dec 63, subj: Manned Mil Space Program, in OSAF 50-63, vol 3; Memo (C), Flax to DDR&E, 4 Dec 63, subj: X-20A Program, in OSAF 370-63.

5. Memo (S), Zuckert to SOD, 4 Dec 63, subj: Manned Mil Space Program, in OSAF 50-63, vol 3.

6. Ltr (S), Hester to SAF, 4 Dec 63, subj: Approaches to a Manned Mil Space Program, in OSAF 50-63, vol 3.

7. Memo (S), Zuckert to SOD, 5 Dec 63, subj: Manned Mil Space Program, in OSAF 50-63, vol 3.

8. Memo (S), Gilpatric to SAF, 5 Dec 63, subj: Changes in DOD Space Programs, in OSAF 50-63; Memo (S), Flax to Zuckert, o/a 30 Nov 63, in OSAF 50-63, vol 4; McNamara News Briefing at Pentagon, 10 Dec 63; Memo (U), McNamara to SAF, 11 Dec 63, subj: Changes in DOD Space Programs.

9. Memo (S), Brown to SAF, 12 Dec 63, subj: X-20 Program, in OSAF 370-63.

10. Memo (U), Zuckert to CSAF, 12 Dec 63, subj: Dyna-Soar Termination, in OSAF 370-63.

11. Memo (U), Zuckert to SOD, 17 Dec 63, subj: Termination of the Dyna-Soar Program; Memo (U), Zuckert to CSAF, 17 Dec 63, subj: Dyna-Soar Termination, both in OSAF 370-63; Rprt (U), 17 Dec 63, unsigned, subj: X-20 Termination Status; Msg (U), SCK 17-12-61, AFSC to ASD, 17 Dec 63, both in Space Div X-20 (Dyna-Soar) Termination File.

12. Ltr (U), M/Gen H.C. Donnelly, Asst DCS/R&D, to ASAF (R&D), 3 Jan 64, subj: Items Recommended for Discontinuing; Ltr (U), Estes to Ferguson, 8 Jan 64, subj: X-20A Technology, both in Space Div X-20A (Dyna-Soar) Termination File.

13. Memo (U), Zuckert to SOD, 15 Jan 64, subj: Continuing Work on Dyna-Soar Program, in OSAF 370-63; Memo (U), Flax to DCS/R&D, 18 Jan 64, subj: X-20A Items Recommended for Continuation, in OSAF 268-64; Msg (U), AFRDDG 86985, USAF to AFSC et al, 22 Jan 64, in Space Div X-20 (Dyna-Soar) Termination File.

14. Memo (S), Brown to ASAF (R&D), 30 Jan 64, subj: Dyna-Soar Research and Dev Programs to be Continued; Memo (U), Flax to Dep DDR&E, 6 Mar 64, subj: Funding Status of Dyna-Soar Program, both in OSAF 268-64.

15. Hist (U), D/Develop, Jan-Jun 64, pp 91-100.

16. Ibid.

Chapter IV

1. Cantwell, pp 31-33; Background Paper (S), o/a Dec 64, subj: DOD/NASA Gemini Experiments Program, in Space Div R&D 3-1-1.

2. PCP (S), s/McMillan, 2 Jul 63, subj: NASA/DOD Gemini Program (6.34.09.25.4), in OSAF 79-63, vol 4.

3. SOD Decision/Guidance (S), s/Gilpatric, 5 Sep 63, in Space Div Case File, GPPB Book.

4. Ltr (S), B/Gen W.E. Leonhard, C/S AFSC, to USAF (AFRDP), 26 Sep 63, subj: Tech Dev Plan (TDP) for Program 631A, in Space Div Case File, GPPB Book; Rprt (C), Space Panel Mtg 63-16, 1 Oct 63; Rprt (S), ASB Meeting 63-45, 4 Oct 63.

5. Memo (C), McMillan to DDR&E, 14 Oct 63, subj: DOD/NASA Experiments, Tech Dev Plan (TDP) for Program 631A, in Space Div R&D 3.

6. Ltr (S), Col R. Nudenberg, Asst Dep to Comdr MSF, AFSC, to USAF (AFRDP), 13 Dec 63, subj: FY 64 Funding for Program 631A, in Space Div Case File, GPPB Book.

7. Ltr (S), M/Gen O.J. Ritland, Dep to Comdr, MSF, AFSC, to USAF (AFRDP), 13 Jan 64, subj: Program 631A; Memo (C), Flax to DDR&E, 7 Jan 64, subj: DOD/NASA Gemini Experiments, Program 631 A, both in Space Div Case File, GPPB Book, Memo (C), Brown to ASAF (R&D), 13 Jan 64, subj: DOD/NASA Gemini Experiments, Program 631A, in Space Div R&D 3; Memo (C), Brown to SAF, 13 Jan 64, subj: Approval of FY 64 RDT&E Program for Gemini, in OSAF 73-64, vol 1.

8. Ltr (U), Maj J.C. Lamiell, Asst Exec Secy ASB, to ASB members, 13 Jan 64, subj: Notice of Air Staff Board Mtg 64-3, in D/Plans RL(64) 12; Rprt (C), Space Panel Mtg, 64-4, 15 Jan 64; Rprt (C), ASB Mtg 64-3.

9. Memo (C), McMillan to DDR&E, 21 Jan 64, subj: DOD/NASA Gemini Experiments, Program 631A; Ltr (U), McMillan to Seamans, 22 Jan 64; Memo (C), Brown to U/SAF, 23 Jan 64, subj: Gemini Experiments, all in Space Div Case File, GPPB Book; CSAF Decision (S), AFC 15/158, 22 Jan 64, subj: DOD Gemini Experiments Status Report.

10. CSAF Decision, AFC 15/158; Memo (C), Brown to U/SAF, 7 Feb 64, subj: DOD/NASA Gemini Experiments, Program 631A, in Space Div R&D 3-1-1; Memo (C), Brown to SAF, 7 Feb 64, subj: Approval of FY 1964 RDT&E Gemini Program, in OSAF 73-64, vol 1; Memo (C), Flax to DCS/R&D, 14 Feb 64, subj: DOD Experiments, Program 631A, in Space Div Case File, GPPB Book; Program Element (S) 6.34.09.25.4, NASA/DOD Gemini Program (as of Aug 64), in DOD 64-69 Space Projects.

11. Ltr (U), Seamans to McMillan, 4 Feb 64; Ltr (U), Col H. Dorfman, Asst Dep Dir Mil Space Programs, Dep Comdr Space, NASA, to USAF (AFRDP), 25 Feb 64, subj: DOD Experiments, NASA Gemini Flights, both in Space Div R&D 3.

12. Memo (S), McMillan to Zuckert, 7 Mar 63, in OSAF 39-63, ol 1.

13. MFR (U), s/J.C. Jones, 19 Sep 63, subj: Status of Funds for Titan II/GLV Engine Fixes, in Space Div R&D; Plan (C), 7 May 63, subj: Joint Titan II/ Gemini Dev Plan on Msl Oscillation Reduction and Engine Reliability and Improvement, in Space Div R&D 3-2-1.

14. Ltr (S), USAF (AFRRPA) to AFSC (SCCP), 17 Jun 63, subj: Hq USAF RDT&E Program Authorization AF 63-272-600, in Msl & Space Div GLV-6.

15. SAF Directive No 7 (S), in memo to CSAF, 22 Jul 63, subj: Titan II Engine Test Program, in Space Div R&D 3-2-1.

16. Memo (S), Zuckert to SOD, 23 Aug 63, subj: Titan II/Gemini Launch Vehicle Engine Dev, in Space Div Case File, GPPB Book; Ltr (S), Worden to DCS/P&O, 3 Aug 63, subj: Item for Staff Mtg of 5 August 1963 (Titan II/Gemini), in D/Plans

RL (63 12), Sec 2; Rprt (S), ASB Mtg 63-34, 5 Aug 63.

17. Memo (U), Fubini for Brown to SAF, 6 Sep 63, subj: Approval for Engine Improvement Program for Titan II and Gemini, in OSAF 79-63, vol 3; Memo (C), Brown to SAF, 8 Jan 64, subj: Approval of USAF FY RDT&E Gemini Program, in OSAF 73-64, vol 1; Ltr (U), Hall to Adm W. F. Boone, Dep Assoc Adm, NASA for Defense Affairs, 24 Sep 63, in Space Div R&D 3-2-1.

18. Memo of Understanding (U), On Certain Design Requirements for the Gemini Launch Vehicle, s/Seamans, 2 Dec 63, McMillan, 3 Dec 63; MFR (C), s/Lt Col J. J. Anderson, DOD Secretariat GPPB, 16 Oct 63, subj: GPPB Meeting of 11 October 1963; ASSS (U), s/Col L. V. Gossick, Dep D/Develop, 7 Oct 63, subj: GLV Tech Objectives, all in Space Div Case File, GPPB Book: Ltr (U), McMillan for Zuckert to Seamans, 22 Nov 63; Ltr (C), Seamans to McMillan, 21 Nov 63; Ltr (C), Hester to U/SAF and ASAF (R& D), 8 Oct 63, subj: Gemini Launch Vehicle Tech Objectives; all in Space Div R&D 3-2-1; MFR (C), s/Col E.S Popek, D/Plans, 7 Oct 63, subj: DOD/NASA Gemini Program, in D/Plans RL (63) 67-1.

19. Rprt (S), Space Panel Mtg 63-20; Rprt (C), ASB Mtg 63-56, 21 Nov 63; USAF Dev Directive No DD-29 (C), for DOD/NASA - Gemini Experiments, Program 631A, 25 Feb 64; Ltr (U), Estes to USAF (AFRDC Ferguson), 21 Feb 64, subj: Expanded Gemini Stage II Engine Stability Improvement Program; Memo (U), McMillan to DDR&E, 6 Apr 64, subj: Expanded GLV Stage II Combustion Stability Program; Ltr (S), Estes to USAF (AFRDC), 13 Jan 64, subj: Titan II Launch Vehicle Dev Program, all in Space Div Case File, GPPB Book.

20. Ltr (U), AFSC (SCGC) to Seamans, 27 Jan 64, subj: Titan II/Gemini Program Status Summary, in Space Div Case File, GPPB Book.

21. A&A Events, 1963, p 401; Minutes (U), 12th Mtg GPPB, 20 Apr 64, in Space Div R&D 3-1-9.

22. Ltr (U), Seamans to Brown, 18 May 64, in Space Div R&D 6.

23. Ltr (U), Brown to Seamans, 15 Jan 64; Draft Memo (U), DCS/R&D to ASAF (R&D), 16 Jun 64, subj: Study of DOD Experiments on Apollo, both in Space Div R&D 6.

Chapter V

1. Rprt (U) to the President, 23 Jul 63, subj: Titan III Solid Rocket Space Booster Motor Firing, in M&S SLS 6.

2. Memo (C), Col C. J. Kronauer, Ch Space Div, to AFRDD (Gen Curtin, Col Gossick), 24 Jul 63, subj: Titan III, Stage III, Engine Firing, in M&S SLS 6.

3. AFSC Mgt Summary (U), 30 Jun 64, subj: Titan III (624A), in M&S SLS 8-2; Hist (C), D/Dev, Jan-Jun 64, pp 59-63; Hist (S), D/Dev, Jul-Dec 63, pp 94-101.

4. Hist (S), D/Dev, Jan-Jun 64, p 59.

5. Minutes (C), 67th DSMG Mtg, 7 Aug 63.

6. A&A Events, 1964, p 202.

7. Ltr (U), L. E. Turner, Dep for Inst, SAFIL, to Hon Harry R. Sheppard, 19 May 64; Ltr (U), Turner to Sheppard, 12 May 64; both in OSAF 169-64; Msg (U), AFDCEL 79182, USAF to Chief of Engineers, DA, 18 May 64, subj: Restoration of Vertical Test Stand I-36B, Edwards AFB, California, in M&S SLS 2; AFSC Mgt Summary (U), 22 May 64, subj: Titan III (624A), in M&S SLS 8-2.

8. AFSC Mgt Summary (U), 7 Jul 64, subj: Titan III (624A), in M&S SLS 8-2.

9. Memo (U), McMillan to SOD, 23 Nov 63, subj: FY 65 Construction Rqmt for Launch Facilities at PMR, in M&S SLS 6.

10. PCP (C), Titan III, 29 Jun 63.

11. SOD Decision/Guidance (C), s/Gilpatric, 14 Nov 63, subj: 6.44.09.09.4, Titan III Space Booster, in M&S SLS 6.

12. SPD (C) No 624A-64-1 for Titan III Space Booster, 16 Dec 63, s/Maj Gen R. D. Curtin, in M&S SLS 6.

13. Ltr (U), Lt/Col A. C. Weidenbusch, Asst Exec Secy, ASB, to ASB members, 9 Mar 64, subj: Notice of Air Staff Board Mtg, in D/Plans RL (64) 12; Subject Resume (C), Air Staff Board Mtg 64-13, undated, subj: Titan III Status Report and SPP, in ASB 64-13; Rprt (C), Space Panel Mtg 64-8, 10 Mar 64; Rprt (U), ASB Mtg 64-13; Minutes (C), 85th DSMG Mtg, 20 Mar 64.

14. Ibid.

15. Memo (C), Flax to DCS/R&D, 2 Aug 63, subj: Payloads for Titan III, in M&S Titan III Flight Test Program.

16. Ltr (C), M/Gen R. D. Curtin, D/Develop, to ASAF (R&D), 21 Aug 63, subj: Payloads for Titan III, in M&S Titan III Flight Test Program.

17. Plan (U), Titan III Follow-on Production, prep by SSD, Aug 63, in M&S SLS 6.

18. Ltr (U), Col H. Gainer, actg Ch Space Div, to D/Dev (Gen Curtin), 18 Nov 63, subj: Titan III Production Plan; Ltr (U), M/Gen J. R. Holzapple, actg DCS/S&L, to AFSC, 24 Oct 63, subj: Titan III Production Program; Ltr (S), Leonhard to USAF (AFRDDG), 2 Oct 63, subj: Titan III Follow-on Production Plan, all in M&S SLS 6.

19. Ltr (U), Hester to AFSC, 11 Apr 64, subj: Booster Rqmts and Production; Ltr (C), Schriever to LeMay, 28 Mar 64, subj: Titan III Production; Ltr ( ), Ritland to USAF (AFRDDG), 28 Nov 63, subj: Titan III Follow-on Production; Nine-Year Estimates; Memo (U), Flax to DDR&E, 9 Dec 63, subj: Preliminary Titan III Production Plan, all in M&S SLS 6.

20. Memo (U), Brown to SAF, 20 Dec 63, subj: Approval of USAF FY 64 RDT&E Titan III Space Booster Program, in M&S SLS 6.

21. List (U), 624A R&D Program Payload Considerations Constraints on Users, published by AFSC 1 Oct 63; Ltr (U), Estes to Dr. R. L. Sproull, ARPA, and Dr. A. T. Waterman, NSF, 24 Oct 63; Ltr (U), Ritland to Seamans, 21 Oct 63; Ltrs (U), Bleymaier to ASD, RTD, BSD, ESD, and OAR, 4 Oct 63, all soliciting payloads for Titan III, both R&D and follow-on; MFR (C), s/Lt Col N. D. Austin, 10 Feb 64, subj: Briefing on Titan III "Piggyback" Payloads, all in M&S SLS 3.

22. Msg (U), AFRDDG 78916, USAF to AFSC, 17 Dec 63; Msg (C), SSBC 19-12-9, SSD to AFSC & USAF, 20 Dec 63, both in M&S Titan III Flight Test Program; Msg (U), AFRDDG 69805, USAF to AFSC, 15 Apr 64; Ltr (U), Seamans to Brown, 17 Apr 64; Ltr (U), Ritland to Seamans, 4 Jun 64, all in M&S SLS 3.

23. Memo (U), Flax to Zuckert, 15 Jul 64.

Chapter VI

1. Cantwell, pp 51-6.

2. Memo (S-461, SAR-Gp 4), Zuckert to SOD, 29 May 63, subj: Report on Launch of Midas VII, in OSAF 129-63.

3. Ltr (S-461, SAR-Gp 4), Col J. J. Pellegrini, Chief, M&S Div, D/Develop, to AFCCS et al, 30 Jul 63, subj: Report of AF Space Program Activity, in OSAF 50-63, vol II.

4. Hist (S-461, SAR-Gp 1), D/Plans, Jul-Dec 63, SAR Annex, pp 174-75.

5. Rprt (S), ASB Meeting 63-44, 25 Sep 63; Rprt (S), Air Defense Panel Mtg 63-35, 25 Sep 63.

6. Atch 3 (Ltr, Weidenbusch to members ASB, 23 Sep 63) (S-461, SAR-Gp 4), Introductory Outline, 461 Program, in D/Plans RL(63) 12, Sec 2; ASSS (S-461, SAR-Gp 4), s/Curtin, 30 Sep 63, subj: Program 461, in OSAF 50-63, vol 3; CSAF Decision AFC 4/29 (S), 1 Oct 63, subj: Program 461.

7. Memo (S-461, SAR-Gp 1), Zuckert to SOD, 22 Oct 63, subj: Program 461, in OSAF 23-64, vol 1.

8. Memo (S), Brown to ASAF (R&D), 7 Nov 63, subj: Program 461, in OSAF 123-63; Msg (S), AFRDDF 70612, USAF to AFSC, 12 Nov 63, subj: Program 461, in M&S ADM 5-3.

9. Msg (S), AFRDDF 77471, USAF to AFSC, 12 Dec 63, subj: Program 461, in M&S ADM 5-3.

10. Memo (S), Brown to SAF, 14 Jan 64, subj: Approval of USAF FY 1964 RDT&E Program 461, in OSAF 73-64, vol 1.

11. Memo (S), Brown to ASAF (R&D), 15 Jan 64, subj: Program 461, in OSAF 23-64, vol 1.

12. ASSS (S-461, SAR-Gp 1), s/Curtin, 21 Feb 64, subj: Program 461, in M&S ADM 5-3.

13. Memo (S-461, SAR-Gp 4), Flax to DDR&E, 5 Mar 64, subj: Program 461, in OSAF 23-64, vol 1.

14. Memo (S), Brown to ASAF (R&D), 18 Mar 64, subj: Program 461, in OSAF 23-64, vol 1.

15. Memo (U), Brown to SAF, 23 Mar 64, subj: Approval of USAF FY 1964 RDT&E Program 461, in OSAF 73-64, vol 1.

16. Memo (S-461, SAR-Gp 4), Zuckert to DDR&E, 29 Jun 64, subj: Program 461, in M&S FIN 1-4.

17. Ltr (S-461, SAR-no Gp), Pellegrini, 461 PEM, to SAF-FM et al, 25 May 64, subj: Draft No 2 of PCP No 64-42, Program 461, in OSAF 23-64, vol 1.

Chapter VII

1. Cantwell, pp 70-76.

2. Rprt (S), ASB Meeting 63-42, 20 Sep 63; Rprt (S), Air Defense Panel Meeting 63-33, 2 Sep 63; Minutes (S), 71st Mtg DSMG, 25 Sep 63; SAF Directive No 12 (S), in Memo, Col D.R. Daughtrey, Exec Asst OSAF, to CSAF, 25 Sep 63, in OSAF 175-63; PSPP (S), 2d revision Program 437, Phase II, 21 Aug 63, in OSAF 50-63, vol 4 (bulky); Memo (S), Zuckert to SOD, 4 Oct 63, subj: Program 437 Proposed System Package Plan, in OSAF 50-63, vol 4; Atch 1 (S) (Ltr, Lamiell to Members ASB, 16 Sep 63,) ASB Presentation Outline, Program 437, Phase II-PSPP and PCP, s/Lt Col Kendall Russell, PEM, Program 437.

3. Subject/Issue Consideration (S), 2 Dec 63, subj: S/I Program 437-Phase II (Air Force) (2.10xx.01.4) in Space Div R&D 1.

4. Hist (S), D/Develop, Jan-Jun 64, pp 102-3.

5. Ltr (S), Lt/Col K. Russell, S/D Div, D/Dev, to Asst Dir, Ranges and Space Ground Support, DDR&E, 17 Feb 64; Ltr (S), Russell to Asst Dir Ranges and Space Ground Support, DDR&E, 2 Mar 64, subj: Report of AF Space Activities; Ltr ( ), Pellegrini to Asst Dir Ranges and Space Ground Support, DDR&E, 22 Apr 64, subj: Rprt of AF Space Activities, all in OSAF 23-64, vol 1; Ltr ( ), Russell to Asst Dir Ranges and Space Ground Support, DDR&E, 1 Jun 64, subj: Rprt of AF Space Activities, in Space Div R&D 1.

6. Memo (S), Zuckert to SOD, 9 Jun 64, subj: Anti-Satellite Capability, in OSAF 23-64, vol 1.

7. Cantwell, pp 65-70.

8. Ltr (S), Estes to USAF (AFRDD), 18 Apr 64, Program 706 Phase O Results, in Space Div; Rprt (S), SSD, 15 Apr 64, subj: Program 706 Phase O Study Results, both in Space Div R&D 8.

9. Msg (S), AFRDPE 86373, USAF to AFSC, 11 Jan 64, in Space Div R&D 8.

10. Cantwell, p 76; Memo (C), Fubini for Brown to ASAF (R&D), 30 Jul 63, subj: Modification of Existing Anti-Satellite Programs and Follow-on Programs, in OSAF 50-63, vol II.

11. Summary Outline (-893, SAR-Gp 4), S/Russell, Program 893, 3 Oct 63, in Plans RL (63) 12, Sec 2.

12. Rprt (S-893, SAR-Gp 4), ASB Mtg 63-46, 10 Oct 63.

13. Memo (S-893, SAR-Gp 1), Flax to DDR&E, 16 Oct 63, subj: Program 893.

14. Memo (S), McMillan to CSAF, 9 Dec 63, subj: Program 437; Memo (S), McMillan to CSAF, 9 Dec 63, subj: Satellite Interception, both in OSAF 50-63.

15. Memo (S-437X, SAR-Gp 4), McMillan to Flax, 24 Feb 64, subj: Program 437X; Ltr (S-437X, SAR-Gp 4), Hester to U/SAF, 23 Dec 63, subj: Program 437, both in OSAF 50-63, vol 4; Ltr (S-437X, SAR-Gp 4), Curtin to AFSC, 20 Dec 63, subj: Satellite Interception, in Space Div R&D 1-1.

16. MFR (S-437X, SAR-Gp 4), s/Lt Col R.C. Reagle, Joint Staff JCS, 23 Mar 64, subj: Program 437X, in D/Plans RL (64) 67-1-3.

17. PCP (S-Gp 1) Program 437, 2.10.06.01.4, s/McMillan, 15 Apr 64, in AFRDSC R&D 2.

18. PTDP (S-437Y, SAR-Gp 4), 11 May 64, Program 437Y, in Space Div R&D 3.

19. Hist (S), D/Develop Plans, Jan-Jun 64, pp 57-8.

Chapter VIII

1. Cantwell, pp 77-85.

2. Rprt (U), Military Operations Subcmte, 88th Cong., 2d Sess., Satellite Communications, pp 51-53; Ltr (U), Vance to J.R. Charyk, Pres ComSatCorp, 10 Jul 64, in D/Plans RL (64) 67-1.

3. Ltr (S), Ferguson to Flax, 12 Nov 63, subj: Program 369 Contract Negotiations, in D/Dev Chronology, Pt II; Msg (S), AFRDDD 73755, USAF to AFSC, 18 Nov 63; Memo (C), Harry Davis, Dep for Research, ASAF (R&D), to Dep DDR&E, 15 Nov 63, subj: Communication Satellite Program Contract Extension; Memo (S), Zuckert to SOD, 19 Dec 63, subj: Program 369; Memo (S), Zuckert to DDR&E, 29 Jun 64, subj: FY 64 Funds Required to Continue Program 369, all in OSAF 81-63; Memo (S), Brown to SAF, 23 Jan 64, subj:

Approval of USAF FY 1964 Program 369, in OSAF 354-64; Memo (C), Fubini for Brown to SAF, 19 Feb 64, subj: Approval of USAF FY 1964 RDT&E Program 369; Memo (C), Brown to SAF, 20 Apr 64, subj: Approval of USAF FY 1964 RDT&E Program 369; Memo (C), Fubini to SAF, 9 Jun 64, subj: Approval of USAF FY 1964 RDT&E Program 369; Memo (C), Fubini for Brown to SAF, 24 Jun 64, subj: Approval of USAF FY 1964 RDT&E Program 369, all in OSAF 73-64, vol 2.

4. Hist (C), D/Develop, Jul-Dec 63, p 40.

5. Memo (C), Brown to ASAF (R&D) and DCA, 26 Jul 63, subj: Reorientation of the Medium Altitude System, Defense Communications Satellite Program, in D/Dev Chronology, Pt I.

6. MFR (S), s/Lt Col N. Polio, D/Dev, 23 Aug 63, subj: Program 369, in OSAF 50-63, vol 3.

7. Memo (C), Fubini for Brown to ASAF (R&D), 12 Oct 63, subj: Application of Gravity Gradient Stabilization to Program 369, in AFRDDD Chronology, Pt II.

8. Memo (U), Davis to DDR&E, 22 Jan 64, subj: Application of Gravity Stabilization to Program 369; ASSS (C), s/Curtin, 17 Jan 64, subj: Application of Gravity Gradient Stabilization to Program 369, both in OSAF 50-63, vol 2; Memo (U), Fubini to ASAF (R&D), 10 Mar 64, subj: Application of Gravity Gradient Stabilization to Program 369, in OSAF 23-64, vol 1.

9. Hearings, Military Operations Subcmte, 88th Cong., 2d Sess., Satellite Communications-1964, pp 176-83.

10. Ltr (S), Col H. Laybee, Asst Dep Dir Aerospace Plans, D/Plans, to Asst Dir/Plans for Jt and NSC matters (Daugherty), Dep Dir/Plans (Worden), Dir/Plans (Carpenter), 29 Feb 64, subj: Qualitative Opl Rqmt (QOR) for an Air Force Communications Satellite (COMSAT) Sys, in D/Plans RL(64) 67-1.

11. Memo (U), Worden to D/Opl Reqts, 2 Mar 64, subj: QOR on AF Communications Satellite (COMSAT) Sys, in D/Plans RL(64) 67-1; Msg (S), CSXPDA 3228C, AFCS to USAF, 18 Mar 64, subj: AF Policy on ComSATS, in M&S SLS 3.

12. Memo (U), Fubini to ASAF (R&D) and DCA, 29 Jun 64, in OSAF 354-64.

Chapter IX

1. PCP (S), s/McMillan, 3 Jul 63, 6.34.09.87.4-2, Advanced Reentry & Precision Recovery Capability, in OSAF 79-63, vol 4.

2. Chris Butler, "First ASSET Transmits Valuable Data Before Disappearing in Atlantic," in Missiles and Rockets, 23 Sep 63.

3. Ibid.; Hist (U), Sci & Tech, Jan-Jun 64, pp 59-60.

4. Ltr (S), Flax to Bisplinghoff, NASA, 29 Apr 64, in OSAF 23-64, vol 1.

5. Memo (S), McMillan to DCS/R&D, 23 Jan 64, subj: Transfer of M-103, in OSAF 23-64, vol 1; Memo (C), Fubini for Brown to SAF, 2 Mar 64, subj: Approval of USAF FY 1964 RDT&E Advanced Reentry and Precision Recovery (ASSET) Program, in OSAF 73-64, vol 1.

6. Program Element (C) PE 6.34.09.87.4, Spacecraft Tech & Advanced Reentry Tests (START), in 64-69 DOD Space Projects.

7. A&A Events, 1964, p 141; Daily Staff Digest (U), No 143, 24 Jul 64.

8. Memo (S), Flax to DDR&E, 5 Jun 64, subj: Release of Funds for M-103 Project, in Space Div R&D 7; Hist (U), D/Dev Plans, Jan-Jun 64, pp 59-60.

9. Cantwell, pp 13-4.

10. Ltr (C), Brown to Glenn T. Seaborg, Chmn AEC, 10 Jul 63, in OSAF 425-63.

11. Memo (C), Fubini for Brown to ASAF (R&D), 24 Jul 63, subj: Program 626-FY 1964 Funding; Ltr (S), Fubini for Brown to Seaborg, 24 Jul 63; Ltr (S), Flax to A.R. Luedecke, AEC Gen Mgr, 29 Jul 63, all in OSAF 425-63.

12. Memo (S), Flax to CSAF, 29 Jul 63, subj: Program 626, FY 64 Funding, in OSAF 425-63; Memo (U), Hall to DDR&E, 16 Oct 63, subj: Snapshot, in OSAF 25-64.

13. Ltr (S), Luedecke to Brown, 31 Oct 63; Ltr (S), Luedecke to Flax, 31 Oct 63; Memo (C), Brown to ASAF (R&D), 6 Dec 63, subj: Snapshot, all in OSAF 425-63.

14. Memo (U), Flax to Dep DDR&E (Space), 16 Dec 63, subj: AEC FY 65 Budget for Flight Test of SNAP-10A; Memo (U), Flax to DDR&E, 8 Jan 64, subj: Snapshot, both in OSAF 425-63; Memo (C), Hall to ASAF (R&D), 16 Jan 64, subj: FY 1965 Budget for Flt Test of Snap 10A; Msg (U), SARRD 86812, to AEC, 20 Jan 64; Memo (U), Col C.B. Daughtrey, Exec Asst to V/CSAF, to V/CSAF, 29 Jan 64, Termination of Snapshot Program, all in OSAF 252-64.

15. William Beller, "Joint Committee Raps DOD, AEC," in Missiles and Rockets, 2 Mar 64.

16. Ltr (U), Hon Chet Holifield to Zuckert, 6 Feb 64; Ltr (U), Zuckert to Holifield, 25 Feb 64, both in OSAF 252-64.

17. A&A Events, 1964, p 144; Ltr (U), Hon J.O. Pastore to Zuckert, 31 Mar 64; Ltr (U), Brown to Hon Melvin Price, 20 Apr 64; Msg (U), USAEC (Luedecke) to SAF (Flax), 26 Mar 64, all in OSAF 252-64.

18. Ltr (U), Zuckert to Pastore, 21 Apr 64; Ltr (U), Flax to Luedecke, 29 Apr 64; Memo (U), Flax to DDR&E, 11 May 64, subj: Snap-10A Program, all in OSAF 252-64; Memo (U), Brown to SAF, 28 May 64, subj: Approval of USAF FY 64 RDT&E Program 626, in OSAF 73-64, vol 2.

19. Ltr (U), Luedecke to Brown, 19 May 64; Ltr (U), Luedecke to Zuckert, 19 May 64; Ltr (U), Zuckert to Seaborg, 9 Jun 64; Ltr (U), Seaborg to Zuckert, 22 Jun 64, all in OSAF 252-64.

20. CSAF Policy Book, 1964, Item 11-2 (S), 1 Jan 64, subj: Nuclear Space Power (Snapshot: Snap-50. Spur); Ltr (U), Seaborg to Zuckert, 2 Aug 63, in OSAF 425-63; SOD Decision/Guidance (C), 16 Aug 63, s/Gilpatric, subj: 6. 34. 09. 12. 4-1, Space Power Unit; ASSS (U), s/W. D. Downs & Col W. A. Tesch, Actg Asst for Nuc Eng. DCS/R&D, 21 Aug 63, subj: Format B on Program Change Number 6. 34. 09. 12. 4-1; Memo (C), N. E. Harlen, Actg SAF to SOD, 23 Aug 63, subj: as above, both in OSAF 79-63, vol 3; Ltr (U), Douthett to USAF (AFRNE), 21 Aug 63, subj: SNAP 50/SPUR Study Requirements, in OSAF 79-63, vol 3.

21. Hist (S), D/Dev, Jul-Dec 63, pp 64-5.

22. Msg (S), AFRDDF 77815, USAF to DC & AFSC, 12 Dec 63; Msg (S), AFRDDF 76261, USAF to AFSC & ADC, 5 Dec 63, both in M&S ADM 5-3.

23. Hist (S), D/Aerospace Prog, Jul-Dec 63, p 19; Hist (S), D/Op Reqts, Jul-Dec 63, p 3.

24. CSAF Policy Book, 1964, Item 11-23 (S), subj: Spadats.

25. MFR (S), s/Maj J. E. White, S/D Div, D/Dev, 13 Dec 63, subj: Results of 496L/437 Dry Run, in M&S ADM 5-3.

26. Rprt (S), Air Defense Panel Mtg 64-34.

27. Hist (U), D/Sci & Tech, Jul-Dec 63, pp 38-40; CSAF Policy Book, 1964, Item 11-17 (C), subj: Standardized Space Guidance Sys.

28. SOD Decision/Guidance (C), s/Gilpatric, 6 Aug 63, subj: Standardized Space Guidance PE 6. 34. 12. 03. 4 (new), in M&S SLS 6.

29. Memo (U), Lt Col W. K. Richert, Space Div, to Curtin, subj: Standardized Space Guidance Sys (SSGS)--Statement of work review; MFR (U), s/Lt Col N. D. Austin, Space Div, 23 Aug 63, subj: Standardized Space Guidance Sys Work Statement; Ltr (U), Ferguson to Davis, 27 Aug 63, subj: as above; Memo (U), Flax to DDR&E, 3 Sep 63, subj: Standardized Space Guidance, all in M&S SLS 6; Hist (S), D/Sci & Tech, Jan-Jun 64, p 45.

30. Program Element (C), PE 6. 44. 09. 18. 4, Standardized Space Guidance, in 64-69 DOD Space Projects.

31. MFR (S-893, SAR-Gp 4), s/Lt Col E. A. Novak, PEM 823 Program, 7 Oct 63, subj: Program 823 Dev Program, in OSAF 50-63, vol 3.

32. Ltr (S-823, SAR-Gp 3), Novak to Asst Dir of Ranges and Space Ground Support, DDR&E, 3 Oct 63, subj: Forecast of AF Space Program Activities, in OSAF 50-63, vol 3.

33. Ltr (S-823, SAR-Gp 4), Novak to SAF et al, 17 Oct 63, subj: Report on AF Space Program Activity; Ltr (S-823, SAR-Gp 4), Novak to SAF et al, subj: Program 638-Vela Hotel; Ltr (S-283, SAR-Gp 4), Novak to SAF et al, 21 Oct 63, subj: Report on AF Space Program Activity, all in M&S ADM 5-3

34. A&A Events, 1964, p 35; 190; Hist (S-823, SAR-no Gp), D/Dev, Jan-Jun 64, pp 38-9.

35. Cantwell, pp 89-93.

36. Ltr (C), Kronauer to Curtin, 23 Jul 63, subj: Large Solid Propellant Motor Program, in M&S LSM 6; Hist (C), D/Dev, Jul-Dec 63, pp 87-91.

37. Ltr (C), Nuenberg to USAF (AFRDDG), 14 Aug 63, subj: Large Solid Propellant Motor Program 623A; Staff Study (U), 18 Aug 63, s/Dr. Chuette, Col Robins, subj: Alternatives for the Continuation of the Large Solid Propellant Motor (Program 623A), both in M&S LSM 6.

38. SOD Decision/Guidance (C), s/Gilpatric, 19 Nov 63.

39. Ibid., Memo (U), Zuckert to SOD, 30 Nov 63, subj: OSD Decision on Large Solid Propellant Motor; Msg (U), AFRRPA 76469, USAF to AFSC, 6 Dec 63; Msg (C), AFRDC 83201, USAF to AFSC, 30 Jul 63, Personal, Ferguson to Estes, subj: Large Solid Motor Program; Msg (U), SCGV 11-9-22, AFSC to USAF, Personal Ferguson from Estes, 11 Sep 63, subj: Large Solid Propellant Motor Program; Msg (U), AFRDC 94812, USAF to AFSC, Personal Estes from Ferguson, 14 Sep 63, subj: as above, all in M&S LSM 6.

40. Memo (U), Brown to SAF, 5 Dec 63, subj: Approval of USAF FY 1964 DDR&E Large Solid Propellant Motor Program, in OSAF 97-63, vol 4.

41. Ltr (U), Brown to Seamans, 5 Nov 63, in OSAF 850-63; Ltr (U), Seamans to Brown, 16 Dec 63; Ltr (U), Brown to Seamans, 13 Feb 64, both in OSAF 169-64.

42. SPD (C), Large Solid Propellant Motor (SPD 623A-64-1 PE 6.34.09.30.4), 13 Jan 64, in Space Div R&D 3-7; Ltr (U), Col T.B. Zinn, Jr., DCAS, AFSC, to USAF (AFRDDG), 12 Mar 64, subj: Transmittal of Program 623A SPP, in M&S LSM 6; Rprt (C), Space Panel Mtg 64-9, 17 Mar 64; Atch 1 (ltr, (C), Deheart to Members ASB, subj: Notice of Air Staff Board Mtg 64-14, 16 Mar 64), Introductory Outline, Large Solid Propellant Motor, in D/Plans RL(64) 12; Rprt (C), ASB Meeting 64-14, 19 Mar 64; SAF Directive No 24 (U); Memo for CSAF, 20 Mar 64, subj: Large Solid Propellant Motor SPP, in Space Div R&D 3-7; Memo (C), Flax to DDR&E, 23 Mar 64, subj: SPP for Large Solid Propellant Motor, in OSAF 169-64; Minutes (C), 86th meeting of DSMG, 23 Mar 64.

43. A&A Events, 1964, p 240; Hist (U), D/Dev, Jan-Jun 64, pp 33-5.

44. Summary (S), undated, prep by Lt Col Timmons, AFRDDC, "Meteorological Satellite Background," in Space Div R&D 25

45. Ltr (C), Rubelito to Dryden, 22 Jan 63, [illegible]; Memo (C), JCS to SOD, 5 Mar 63, subj: Meteorological Satellite Reqmts; Memo (C), JCS to SOD, 12 Dec 63, subj: as above, both in D/Plans RL (63) 67-1, sec 4; Memo (C), Rubel for Brown to ASAF (R&D), 13 Jan 64, subj: Meteorological Satellites, in D/Plans RL (64) 67-1; Memo (C), Rubel for Brown to JCS,

23 Jan 63, subj: Meteorological Satellite Rqmts, in Space Div R&D 25.

46. Timmons Paper, cited above.

47. Ibid.

48. Ibid.

49. Memo (C), Fubini for Brown to JCS, 3 Feb 64, subj: Meteorological Satellite Rqmts; Rprt (C), Joint Staff to JCS, 2 Mar 64, subj: as above, both in D/Plans RL(64) 67-1.

50. Ltr (U), S. F. Singer, Dir, Natl Weather Sat Ctr, to Senator Clinton P. Anderson, 17 Mar 64, in Hearings, Cmte on Aeronautical and Space Sciences, 88th Cong., 2d Sess., NASA Authorization for Fiscal Year 1965, Appendix C.

51. Ltr (S), Fubini to Dr. R. White, Ch, Weather Bureau, 1 Apr 64, in D/Plans RL(64) 67-1.

52. Memo (S), Fubini to JCS et al, 23 Apr 64, subj: National Weather Satellite Program, in D/Plans RL(64) 67-1.

53. Memo (S), McMillan to Schriever, 25 Feb 64, subj: Completion of Program 162; Memo (S), McMillan to LeMay, 25 Feb 64, subj: as above; Memo (S), LeMay to McMillan, 16 Mar 64, subj: as above, all in OSAF 23-64, vol 1.

54. Memo (U), Col P. Worthman to M. Rosenberg, undated.

55. Memo (S-435, SAR-Gp 1), J. H. Wakelin, ASN (R&D), to U/SAF, 6 Dec 63, subj: Project 435; Memo (S-435, SAR-Gp 1), Brown to ASN (R&D), 19 Dec 63, subj: Project 435 Vehicle Procurement, both in OSAF 50-63, vol 4.

56. Memo (U), Jones to U/SAF, 3 Jan 64, subj: NASA Scout Ad Hoc Committee Report; Memo (S-435, SAR-Gp 1), Flax to DDR&E, 6 Feb 64, subj: Project 435 Vehicle Procurement, both in OSAF 50-63, vol 4.

57. Memo (S-435, SAR-Gp 1), Brown to ASAF (R&D), 22 Feb 64, subj: NASA/DOD Scout Launch Vehicle, in OSAF 23-64, vol 4; Memo (U), Brown to ASAF (R&D), 13 May 64, subj: Fourth Stage Scout Motor, in OSAF 23-64, vol 2.

GLOSSARY

AACB	Aeronautics and Astronautics Coordinating Board
A&A Events	NASA Annual Reports, Astronautics and Aeronautics Events
ADC	Air Defense Command
AEC	Atomic Energy Commission
AEV	Aerothermodynamic Environmental Vehicles
AFCS	Air Force Communications Service
AFSC	Air Force Systems Command
AMR	Atlantic Missile Range
APTS	Automatic Picture Transmission Subsystem
ARPA	Advanced Research Projects Agency
ASAF (R&D)	Assistant Secretary of the Air Force, Research and Development
ASB	Air Staff Board
ASD	Aeronautics System Division
ASSET	Aerothermodynamic/elastic Structural Systems Environmental Tests
ASV	Aerothermodynamic Structural Vehicle
ComSatCorp	Communications Satellite Corporation
DCA	Defense Communications Agency
DDR&E	Director of Defense Research and Engineering
DRM	Discoverer Radiometric
DSMG	Designated Systems Management Group
DTS	Detection Test Series
FTV	Flight Test Vehicle
GLV	Gemini Launch Vehicle
GPPB	Gemini Program Planning Board
ICBM	Intercontinental Ballistic Missile

ITL	Integrate-Transfer-Launch
JCS	Joint Chiefs of Staff
MACS	Medium Altitude Communication Satellite
MODS	Military Orbital Development System
MOL	Manned Orbiting Laboratory
MRBM	Medium Range Ballistic Missile
MTBF	Mean Time Before Failure
NASA	National Aeronautics and Space Administration
NMFPA	Naval Missile Facility, Point Arguello
NOSS	National Orbital Space Station
OSD	Office of Secretary of Defense
OSS	Optical Space Surveillance Sensor
PCP	Program Change Proposal
PSPP	Partical System Package Plan
PTDP	Preliminary Technical Development Plan
QOR	Qualitative Operational Requirement
RDT&E	Research, Development, Testing, and Engineering
RTS	Research Test Series
SLBM	Submarine Launched Ballistic Missile
SNAP	AEC Systems for Nuclear Auxilliary Power
SPACETRACK	ADC-operated USAF Component of SPADATS
SPADATS	Space Detection and Tracking System
SPP	System Package Program
SPUR	Space Power Unit Reactor
SSD	Space System Division
START	Spacecraft Technology and Advanced Reentry Tests
TOSS	Tiros Operational Satellite System